Report on Whooping Crane Recovery Activities
2019 breeding season-2020 spring migration

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Executive Summary

Whooping cranes are one of the most rare, highly endangered and intensively monitored bird species in North America. The Aransas-Wood Buffalo population (AWBP), which breeds in northern Canada and winters in Texas, is the only remaining wild, self-sustaining migratory population of whooping cranes. In summer 2019, surveys of the AWBP detected 97 nests (May) and 37 chicks (August) resulting in an average number of chicks fledged per nest (0.38) that was below the 20-year long-term average of 0.49 but within the long-term natural range of variation. In winter 2019-2020 (Jan) the peak population size of the AWB on the primary wintering grounds was estimated as 506 birds (95% CI= 342.6–678.0; CV = 0.168) and additional birds were located outside the survey area. Other populations of reintroduced whooping cranes exist in Wisconsin, Florida, and Louisiana due to the efforts of many government agencies and non-governmental organizations, including the captive breeding centers where whooping cranes are reared for reintroduction. By the end of 2019 there were approximately 506 birds in the AWBP, 162 birds in active reintroduced populations and 144 birds in captivity for a total global whooping crane population of just over 800 birds (Tables 1-2). Nearly all of the growth in the global population, however, occurred in the AWBP, as reintroduced populations continued to see low levels of wild recruitment and population size is maintained via captive chick introduction.

Aransas-Wood Buffalo Population (AWBP)

Overview

The Aransas-Wood Buffalo population (AWBP) of whooping cranes is the only remaining wild, self-sustaining, migratory whooping crane (*Grus americana*) population. The AWBP breed and summer in and around Wood Buffalo National Park (WBNP) in the Canadian jurisdictions of Alberta and the Northwest Territories and migrate >2,400 miles through the Canadian prairies and US Great Plains to the mid-coast of Texas to spend the winter. Whooping cranes from the AWBP was reduced to a mere 15 individuals in 1941 and has rebounded to about 506 this winter, representing a > 4% annual growth rate. The ongoing recovery of this whooping crane population is perhaps one of the greatest endangered species success stories. A wide variety of local, state, federal and private conservation organizations are actively involved in planning and implementing whooping crane conservation efforts.

AWBP breeding grounds update

For the full update, see the attached report prepared by Canadian Wildlife Service

During the 2019 breeding season, water levels in the whooping crane nesting area appeared lower than recent years, but seemed to provide sufficient habitat for nesting cranes. Annual precipitation at Fort Smith, Northwest Territories preceding the breeding season (May 2018 to April 2019) was 75% of the 60-year average. Precipitation during the breeding season (May to August) was 127% of the 60-year average, yet water levels were noticeably reduced during fieldwork in July and August.

In May 2019, aerial surveys detected 97 nests and 28-29 pairs without nests. Because most cranes are not individually banded yet may move during the duration of the survey, the range of pairs reflects the possible number of unique pairs. Of the 97 nests identified, 22 were outside the area designated as CH and 11 of these were also outside WBNP. All nests outside of WBNP were north of the Nyarling River. Nests were not detected on Salt River First Nation reserve lands (i.e., Lobstick Creek) east of WBNP where up to two nesting pairs have been found in recent years. In July, aerial surveys detected 35 pairs with one juvenile each and 60-63 pairs without juveniles. Using information collected during the breeding pair and juvenile surveys, we determined that annual productivity was 0.38 juveniles per nest, below the 20-year average of 0.49 but within the long-term natural range of variation of about 0.20 to 0.80.

Wildfire affected 117,778 ha or 2.6% of Wood Buffalo National Park (WBNP) which is above the 25-year average of 1.6%. Inside the area designated as Critical Habitat (CH) under Canada's Species at Risk Act, fires burned 9,003 ha or 2.2% of that area (above the 25-year average of 1.5%). Of note, a large fire in the Preble Creek nesting area that started in late June encompassed one May nest location, and two other nests occurred within 350 meters of the fire perimeter. However, observations during July surveys confirmed that all three of these nesting pairs were successful in fledgling young (including one family group with two young) despite ongoing fire activity in the area at the time of the survey.

AWBP migration update – Whooping Crane Tracking Partnership

In 2009, a multi-agency, collaborative research and monitoring project to capture and mark whooping cranes was initiated in order to quantify behavior, movement and habitat use of cranes during all aspects of their annual cycle. That project, which continued through 2016, was carried out by the Whooping Crane Tracking Partnership (WCTP, Phase 1), a cooperative effort between five core partners: CWS, US Geological Survey (USGS), US Fish and Wildlife Service (USFWS), the Crane Trust and Platte River Recovery Implementation Program, with additional support from Parks Canada Agency (PCA), the International Crane Foundation (ICF), and the Gulf Coast Bird Observatory. Specific objectives were to: 1) advance knowledge of breeding, wintering, and migration ecology including threats to survival and population persistence; 2) disseminate research findings in reports, presentations, and peer-reviewed literature to provide

reliable scientific knowledge for conservation, management, and recovery of whooping cranes; and 3) minimize negative effects of research activities to whooping cranes.

During Phase 1 of the WCTP, captured birds were fitted with a GPS/PTT (Global Positioning System/Platform Transmitting Terminal) satellite transmitter mounted on a two-piece leg band. Transmitters were programmed to record each bird's spatial location four times daily, recording both daytime and nighttime locations throughout the annual cycle. From December 2009 to February 2014, 68 whooping cranes were captured and marked with satellite transmitters; 37 adults and two juveniles were marked on the Texas Gulf Coast wintering grounds and 31 juveniles were marked during the breeding season in WBNP. Transmitters are expected to function for three to five years but the number and frequency of GPS transmissions declines over time. By 2018, most transmitters were offline, but during the migrations of spring and fall, 2018, four and three cranes marked with PTT transmitters provided telemetry data, respectively. Additional information on this project is available here: https://www.platteriverprogram.org/PubsAndData/Pages/ProgramLibrary.aspx (search under Target Species/Whooping Crane). Several scientific publications have resulted from Phase 1 of the WCTP, with additional publications currently under review. Please see literature cited for list of current publications.

In August 2017, a renewed effort was made to capture whooping cranes to mark them with satellite transmitting devices. This work is being undertaken by Phase 2 of the WCTP which consists of four core partners: CWS, PCA, USFWS, and USGS, with additional support from ICF, and the Calgary Zoo. Capture and marking of cranes in Canada is supported by Joint Canada-Alberta Oil Sands Monitoring funding to Environment and Climate Change Canada. The main goal of Phase 2 of the WCTP is to investigate potential risk to whooping cranes from industrial development (e.g., extraction of oil and gas, mining, and wind power).

During the first year Phase 2 of the WCTP, captured birds were fitted with a GPS/GSM (GPS/Global System for Mobile Communication) cellular transmitter (Cellular Tracking Technology LLC, Rio Grande, NJ) with Global Positioning System capabilities mounted on a two-piece leg band. GPS/GSM transmitters were programmed to collect up to 48 GPS locations daily at equal time intervals and to upload location data to the GSM system every 24 hours; this schedule allows for highly detailed information on diurnal and nocturnal (roosting) habitat use during all stages of the annual cycle, and on migratory behavior in spring and fall. In January and February of 2020 FWS and WCTP partners marked 17 adult whooping cranes on the Texas Gulf Coast. Information collected through this phase will build on existing baseline monitoring conducted via satellite telemetry of whooping cranes since 2010.

AWBP wintering grounds update

Additional information from this past winter can be found here:
http://www.fws.gov/refuge/Aransas/wwd/science/updates.html

2019 winter habitat conditions

The first marked whooping cranes arrived on the Texas coastal wintering grounds in and around Aransas National Wildlife Refuge the week of 21 October 2019. Fall arrivals have been about 2 weeks later than normal the last several years. The 2019 precipitation total (30.13 inches recorded at Aransas NWR RAWS) was below the annual average of 38 inches for the Refuge (USFWS Aransas NWRC CCP, 2010), with the wettest month of the year (6.07 inches) occurring in June of 2019. After a wet 2018, most traditional freshwater wetlands and ponds on and around Aransas NWR still maintained water during the 2019-2020 wintering season, although overall drying in Refuge habitats was observed. San Antonio Bay salinities remained moderate, generally staying below 20 ppt or less, with a few time periods with salinities <5 ppt following freshwater inflow events and rarely exceeding 25 ppt during the 2019-2020 wintering season (http://lighthouse.tamucc.edu/pq/). Precipitation the first portion of 2020 was average, with January–May 2020 rainfall totaling 12.83 inches.

Given drier conditions than the previous winter, staff at Aransas NWR were able to use prescribed fire to improve whooping crane foraging opportunities and overall prairie upland condition during the 2019-2020 winter season. A total of 7,970.5 acres were prescribed burned on Aransas NWR complex, with 4,610.8 acres on the Aransas Unit, 2,693.7 acres on the Tatton Unit and 666 acres on the Myrtle Foester Whitmire Unit.

2020 winter abundance survey

For the full 2019-20 report, see attached prepared by U.S. Fish & Wildlife Service. There is also more information available here: https://ecos.fws.gov/ServCat/Collection/Profile/1206

Summary from full report:

The U.S. Fish and Wildlife Service estimated the abundance of whooping cranes in the Aransas-Wood Buffalo population for the winter of 2019–2020. Survey results indicated 506 whooping cranes (95% CI = 342.6–678.0; CV = 0.168) inhabited the primary survey area (Figure 1). This estimate included at least 39 juveniles (95% CI = 26.4–52.3; CV = 0.170) and 192 adult pairs (95% CI = 131.2–262.7; CV = 0.171). Recruitment of juveniles into the winter flock was 8.4 chicks (95% CI = 7.8–9.1; CV = 0.040) per 100 adults.

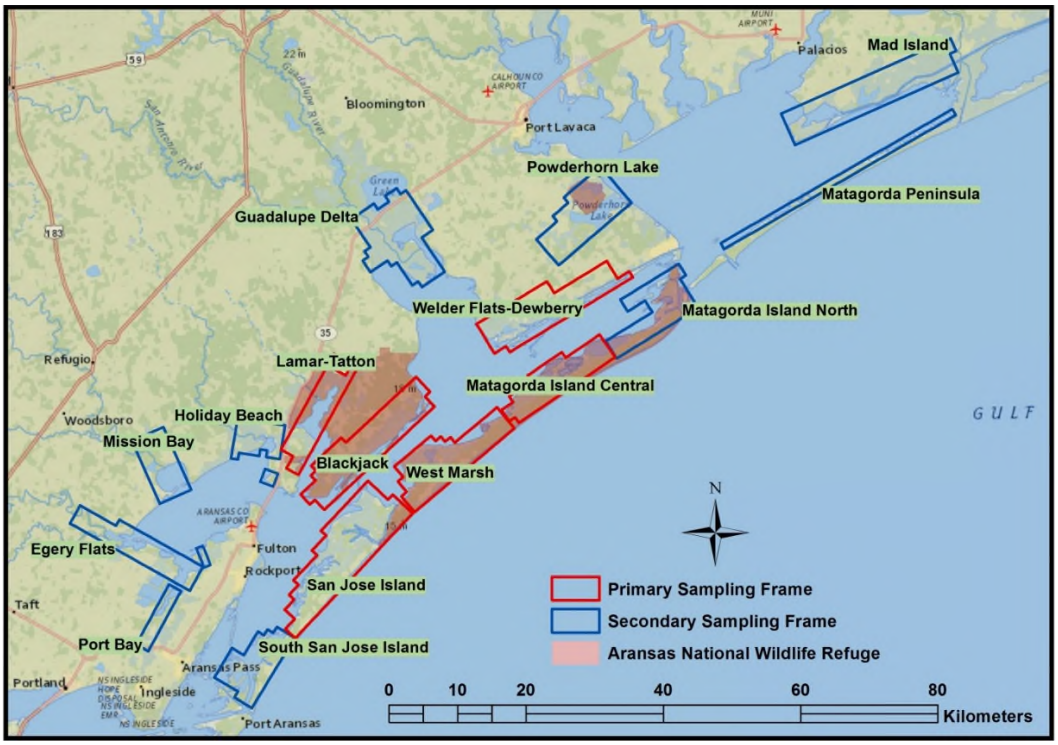

Figure 1. The sampling area used to monitor whooping crane abundance on their wintering grounds along the Texas coast of the Gulf of Mexico, USA.

During winter 2019–2020, the U.S. Fish and Wildlife Service continued to use a Quest Kodiak aircraft and surveys were conducted in late-January. The primary survey areas (approximately 153,950 acres; Figure 1) were surveyed once during January 27–28, 2020. The secondary survey areas (approximately 169,300 acres; Figure 1) were surveyed twice this winter during January 24–27, 2020. A concerted effort was made to survey the secondary areas this year since weather conditions precluded surveying them in winter 2018–2019 and only portions of them have been surveyed since winter 2015–2016.

The long-term growth rate in the whooping crane population has averaged 4.4% (n = 80; 95% CI = 1.85–6.96%). The population remained stable from winter 2017–2018 to winter 2019–2020 (Table 1). The Canadian Wildlife Service reported 24 whooping crane chicks were fledged at Wood-Buffalo National Park in summer 2018 and 37 in summer 2019. Low fledge rates have resulted in reduced recruitment and no population growth since winter 2017–2018 (Figure 2).

Mortalities:

On 30 November 2019, David Brandt, field biologist with USGS Northern Prairies Wildlife Research Center, collected a banded juvenile whooping crane carcass (“3E”) that appeared to have struck a transmission line the night of 26 November 2019 on private lands in Aransas County, TX.

The carcass was sent to the National Wildlife Health Center Lab for necropsy and further analysis. We worked with AEP Texas, the owner of the transmission line, to mark this line in May 2020.

On 23 April 2020, FWS Special Agent Downs collected a banded juvenile whooping crane carcass ("18E") that appeared to have struck a transmission line the night of 20 April 2020 on private lands near Mountrail, ND. The carcass was sent to the National Wildlife Health Center Lab for necropsy and further analysis. We worked with Basin Electric Power Cooperative to verify the line was marked when constructed in 2013.

Reintroduced flocks

Florida non-migratory flock

Current status and future plans

Reproduction milestones for the Florida project include the first nest established in 1996, the first eggs laid in 1999, the first egg hatched in 2000 and the first chick reared to fledging in 2002. Intensive monitoring of the flock was discontinued in June 2012 by the Florida Fish and Wildlife Commission. Since then, monitoring efforts have been opportunistic and have relied heavily on public observations. Florida's non-migratory whooping crane population was approximately 11 individuals at the start of 2019. The flock is comprised of three pairs, one 19-year-old female, and four wild-hatched chicks ranging in ages from 3- to 15-years-old. Given there are no plans for future reintroductions into this flock, biologists from Florida, Louisiana, and the USFWS decided to try and translocate some of the wild-hatched chicks and single cranes to Louisiana to help in recovery efforts. Translocating wild-hatched/wild-reared cranes has not been attempted with previous whooping crane reintroductions. Adding the genetics and life experiences of a wild-reared individual to a population of captive-reared birds could help the overall population.

In late January 2019, biologists from the International Crane Foundation and Florida Fish and Wildlife Conservation Commission trapped the 19-year-old female and a 4-year-old wild-hatched female. The cranes were given a health check and quarantined approximately 2-weeks by our partners at the White Oak Conservation Foundation. They were driven to Louisiana's White Lake Wetlands Conservation Area after being medically cleared. Louisiana Department of Wildlife & Fisheries biologist released the cranes on 7 February 2019. Both remain alive eight months later.

The remaining Florida population has fluctuated since the translocations. A pair that had never successfully bred hatched a chick in May 2019. The chick has since fledged; however, the male of the pair disappeared in June and is presumed dead. The current Florida population is made up of nine cranes: two pairs (2000 male/1993 female & 2000 male/1999 female*), a 2000 female

and her 2019 wild-hatched chick, a 15-year-old wild-hatched female, a 2006 wild-hatched female, and twin 2016 wild-hatched chicks. No breeding was observed in 2020.

Louisiana non-migratory flock

For the full 2019-20 report, see attached prepared by Louisiana Department of Wildlife and Fisheries

Eleven juvenile Whooping Cranes were received in November 2019 from the Freeport-McMoRan Audubon Species Survival Center (ASSC) in New Orleans, Louisiana. They were transported to the White Lake Wetlands Conservation Area (WLWCA) in Vermilion Parish where they were temporarily held in a top-netted pen before being released. Nine survived through the end of the report period. Additionally, one of six known chicks hatched in the wild in 2020 fledged and survived through the end of the report period. The COVID-19 pandemic impacted our ability to track and monitor cranes in remote locations, and it's likely that some nests, and possibly some chicks, went undocumented.

The maximum size of the Louisiana non-migratory population at the end of the report period was 76 individuals (39 males, 36 females, and one unknown), with 68 birds located in Louisiana, seven in Texas, and one in Oklahoma. Based on location data generated via remote transmitters, we documented cranes in 15 parishes throughout Louisiana, with three of those parishes accounting for 87% of the data points within the state. Similar to previous years, a number of Louisiana Whooping Cranes used areas in Texas, mainly in the southeast, with nearly 17% of the data points collected during the report period located there. One crane was also documented using six additional states. In 2020, a pair nested for the first time in Texas after pairing and establishing a territory there the previous year. It is likely that pair will remain and continue to nest in Texas in future years.

During the 2020 breeding season, 12 nesting pairs initiated 22 nests in seven different parishes in Louisiana and one county in southeast Texas. It is likely that several additional pairs nested, but those nests and any resulting chicks were not able to be documented due to their remote and inaccessible locations and restrictions related to the COVID-19 pandemic. Nine pairs consisted of individuals who each had previous nesting experience while three pairs nested for the first time. Seventeen nests from seven pairs were located on private property in actively fished crawfish fields, while the remaining five nests from five pairs were located in marsh habitats - one pair nested in the WLWCA marsh and four nested in marsh habitat on private property.

In 2020, six chicks hatched naturally to five pairs, two of whom had previous parenting experience, while the remaining three were first time parents. One chick survived and fledged at 84 days of age to experienced parents, who have now fledged five chicks between them since 2016. The remaining chicks disappeared at ~11-41 days of age and are presumed dead. Due to

ongoing, significant embryo mortality, we continued submitting adult blood and egg content samples for heavy metal and toxicology screening. The COVID-19 pandemic limited our ability to perform egg manipulations for data-logging egg deployments and egg swaps, although we were able to deploy a few data-logging eggs early in the nesting season. Additionally, restrictions at the captive breeding centers significantly impacted their ability to hatch and rear chicks for release, resulting in no juvenile cranes available for release into the population in the fall of 2020. Although the future is uncertain due to the ongoing pandemic, we do plan to continue with research initiatives to the extent possible in future years while adherring to any regulations or restictions captive centers have in place.

The Louisiana Department of Wildlife and Fisheries (LDWF) continues to educate the public about the Whooping Crane reintroduction program through a variety of means including a new display that will travel to libraries across the state.

Our media campaign continued to focus on raising public awareness regarding both positive and negative aspects of the program, including re-emphasizing the issue around illegal shootings involving Whooping Cranes which accounts for almost 30% of the mortality in the population where a cause of death could be determined. The media plan once again utilized an assortment of methods including billboards, television, and radio advertisements.
Now in its tenth year, the Louisiana Whooping Crane reintroduction has made much positive progress but still has challenges to overcome. We are determined to continue making strides towards our ultimate goal of establishing a self-sustaining population in the state.

Eastern migratory population

For the full 2019-2020 report, see attached prepared by Whooping Crane Eastern Partnership.

During 2019, there were about 86 Whooping Cranes in the Eastern Migratory Population. The majority spent the summer in Wisconsin, with the exception of 6 birds that spent all or part of the summer in Michigan, Iowa, or Illinois (Fig. 1). We recorded a total of 36 nests by 22 breeding pairs of cranes, from which 19 chicks hatched. Three of these chicks made it to fledging, migrated south, and wintered with their parents. In June, two one-year-old cranes who were raised at the Calgary Zoo were released at Horicon National Wildlife Refuge. In October, one parent-reared juvenile was released at White River Marsh State Wildlife Area in a territory of a breeding pair of Whooping Cranes. One additional parent-reared juvenile was released in November at Goose Pond Fish and Wildlife Area in Indiana near a group of sub-adult Whooping Cranes. There were ten confirmed mortalities during 2019, due to powerline collisions, gunshot, predation, bacterial infections, and unknown causes. Members of the Whooping Crane Eastern Partnership captured three adult Whooping Cranes during 2019 for transmitter replacement, as well as 2 wild-hatched juveniles for initial transmitter deployment, which will help us track individuals in this population to inform our management decisions and future releases. Additionally, one adult Whooping Crane was captured and removed from the Eastern Migratory

Population and was placed back into captivity. He had been frequenting a military airport, was no longer responding to hazing activities, and was causing safety hazards for himself and others. In April-May of 2020, we documented 21 first nests and 2 re-nests, 13 of which hatched at least 17 chicks, although by the end of May nesting season was on-going and a full report of the 2020 breeding season will be in the next annual report.

Table 2. Estimated size of wild whooping crane populations in winter 2019-20.

Population	Male	Female	Unknown	Total	Breeding Pairs
Aransas-Wood Buffalo				506	97
Eastern Migratory				86	
Louisiana Non-migratory	39	36	1	76	
Florida Non-migratory				9	
Total in wild populations				677	

Table 3. Number of whooping cranes held at institutional members of the Species Survival Program (SSP) in March 2020. Institutions denoted with a star are designated by the International Whooping Crane Recovery Team and the SSP as captive breeding centers.

Institution	Male	Female	Total
International Crane Foundation, Wisconsin*	21	20	41
Calgary Zoo, Alberta*	14	13	27
Audubon Zoo, Louisiana*	12	11	23
Smithsonian Conservation Biology Institute, Virginia*	5	6	11
Dallas Zoo, Texas*	5	4	9
White Oak Conservation Center, Florida*	5	4	9
San Antonio Zoological Gardens and Aquarium, Texas*	2	2	4
Abilene Zoo, Texas	1	1	2
African Lion Safari, Ontario	1	1	2
Homosassa Springs Wildlife State Park, Florida	1	1	2
Houston Zoo, Texas	1	1	2
Jacksonville Zoo, Florida	1	1	2
Milwaukee County Zoo, Wisconsin	1	1	2
Oklahoma City Zoo, Oklahoma	1	1	2
Omaha Zoo, Nebraska	1	1	2
Sylvan Heights Bird Park, North Carolina	1	1	2
Zoo New England, Massachusetts	1	1	2
Total in captive population	74	70	144

Acknowledgments

No one organization or individual is capable of providing all the necessary elements to recover the magnificent whooping crane. We see this recovery effort not only successful due to the great increase in the whooping crane population over the last 60 + years, but also the great deal of cooperation and collaboration that takes place amongst a wide variety of private, state and federal organizations alongside a slew of highly dedicated individuals. If not for everyone's continued effort to assist in the recovery of this species, it is likely that the species would have been extinct long ago. Our hope, as the biologists tasked by our respective agencies with the coordination of the recovery of this revered species, is that we can all continue to work together to ensure that the species is able to be removed from the endangered species list as recently occurred for the US national bird, the bald eagle. As the population continues to grow, a greater portion of the public will have opportunities to view and appreciate the majesty of the species. We want to thank all the organizations and individuals that contributed to this report along with the wide range of recovery efforts being undertaken.

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APPENDICES

Recovery and Ecology of Endangered Whooping Cranes: Monitoring of the Aransas-Wood Buffalo Population during the 2019 Breeding Season and Fall Migration

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Canadian Wildlife Service
Prairie Region, Environment and Climate Change Canada
Government of Canada

Summary

Annual, long-term monitoring of the Aransas-Wood Buffalo Population (AWBP) of whooping cranes (*Grus americana*, hereafter cranes), which numbers approximately 504 individuals (95% CI: 412.4 to 660.3), is a key element of Canada's efforts to recover the species under the *Species at Risk Act*. In 2019, the Canadian Wildlife Service and Parks Canada conducted surveys for whooping cranes in breeding areas in southern Northwest Territories and northern Alberta, in and adjacent to Wood Buffalo National Park (WBNP). Breeding pair surveys in May detected 97 nests, 22 of which were outside areas designated as containing critical habitat (CH) and 11 were outside WBNP; 28-29 pairs without nests were also observed. Surveys in July detected 37 juveniles in 36 family groups, seven of which were outside CH and five were outside WBNP. Of the 36 family groups, 34 were pairs with one juvenile, one was a pair with two juveniles, and one included a single adult with one juvenile. Annual productivity was 0.38 juveniles per nest, which is below the 20-year average of 0.49 but within the long-term natural range of variation. Of 16 banded family groups observed with juveniles in July and later observed in September-November, 14 and two were re-sighted with and without juveniles, respectively, so apparent survival during this period was 87.5%. Results from monitoring of the AWBP in 2019 highlight the continued increase in the breeding population, although it is still well below Canadian and international recovery goals, and emphasizes the ongoing use of breeding habitat not currently designated as CH.

In addition to long-term monitoring of the breeding population, CWS worked collaboratively with partners in 2019 to implement scientific activities designed to improve our knowledge of the ecology of whooping cranes. In May and July, we conducted fieldwork to implement the first phase of an effort to identify factors that may limit nest success of AWBP whooping cranes, by deploying remote cameras with time-lapse surveillance, autonomous recording units (ARUs) and water level loggers in the whooping crane nesting area. The objective of this work was to evaluate logistical considerations associated with use of this monitoring equipment, which was deployed at 11 inactive whooping crane nests in WBNP, and to collect information to determine if nest predators are attracted to the equipment. In August, we renewed our efforts to monitor movement, behaviour and survival of whooping cranes throughout the annual cycle by capturing and banding 19 fledged juveniles in and near WBNP with coloured leg bands and GPS transmitters. Data collected through this project will build on existing baseline monitoring conducted via satellite telemetry since 2010 and will be used to investigate potential risk to cranes from industrial development.

Background and Rationale

The Government of Canada and its partners, via implementation of the Recovery Strategy for the Whooping Crane in Canada (hereafter RS; Environment Canada 2007) and the joint US-

Canada International Recovery Plan (hereafter IRP; CWS and USFWS 2007), aims to protect, restore, and manage the whooping crane (*Grus americana*) to be self-sustaining in the wild by establishing 1,000 individuals in North America by 2035 (Environment Canada 2007). By reaching this goal and achieving other recovery criteria, the species may be considered for re-designation from Endangered to Threatened under the *Species at Risk Act* (SARA) in Canada, and under the *Endangered Species Act* in the United States. Coordination of activities designed to recover the species, including establishment and operation of a joint International Recovery Team, is governed by a memorandum of understanding between the Canadian Wildlife Service (CWS) of Environment and Climate Change Canada (ECCC), Parks Canada Agency (PCA), the US Fish and Wildlife Service (USFWS), and the US Geological Survey (USGS).

The only naturally occurring population of whooping cranes, the migratory Aransas-Wood Buffalo Population (AWBP), which numbers about 504 individuals (95% CI: 412.4 to 660.3; USFWS 2019), spends half of its annual cycle in Canada. During the summer breeding season (May to September), breeding adults and some non-breeding sub-adults reside in and adjacent to Wood Buffalo National Park (WBNP) in Alberta and the Northwest Territories. During fall (September and October), adults, sub-adults, and juveniles spend up to 4-6 weeks staging in central Saskatchewan before migrating to the Texas Gulf Coast, where they spend winter (November to March) in and near the Aransas National Wildlife Refuge. During spring migration (March and April), cranes return to WBNP and adjacent areas via Saskatchewan, for initiation of breeding in May.

Annual monitoring of the AWBP by CWS and our partners is a key element of Canada's implementation of the RS and IRP, and is specified in those recovery documents as an activity required to achieve recovery goals. Data collected annually are used to (1) track progress towards recovery goals by estimating the abundance and productivity of breeding pairs annually; (2) identify and designate areas as critical habitat (CH) (i.e., areas vital to the survival or recovery of cranes) under SARA; and (3) predict future population dynamics and range expansion of the AWBP. Most breeding pairs nest inside WBNP, but the population has expanded its range outside the national park with up to 11 pairs nesting annually in the Northwest Territories, and up to two pairs on Salt River First Nation reserve lands.

Given the population's small size, we monitor almost all breeding individuals by conducting annual aerial surveys of the abundance of (1) breeding pairs and nests in late spring and (2) juveniles in mid-summer. Information obtained from both surveys is used to derive metrics required by the RS and IRP to track progress towards recovery (i.e., number of breeding pairs, annual productivity). Aerial surveys are conducted in the core breeding areas within WBNP, and in areas outside the national park. This monitoring work has been conducted annually since 1966 by CWS, and in close cooperation with PCA since 2011.

Habitat Conditions in Breeding Areas

Annual precipitation at Fort Smith, Northwest Territories preceding the breeding season (May 2018 to April 2019) was 75% of the 60-year average (Figure 1; Environment and Climate Change Canada 2019). During the 2019 breeding season, water levels in the whooping crane nesting area appeared lower than recent years, but seemed to provide sufficient habitat for nesting cranes. Precipitation during the breeding season (May to August) was 127% of the 60-year average (Figure 1, Environment and Climate Change Canada 2019), yet water levels were noticeably reduced during fieldwork in July and August.

Wildfire affected 117,778 ha or 2.6% of WBNP (above the 25-year average of 1.6%). Inside the area designated as CH, fires burned 9,003 ha or 2.2% of that area (above the 25-year average of 1.5%). Of note, a large fire in the Preble Creek nesting area that started in late June encompassed one May nest location, and two other nests occurred within 350 metres of the fire perimeter. However, observations during July surveys confirmed that all three of these nesting pairs were successful in fledgling young (including one family group with two young) despite ongoing fire activity in the area at the time of the survey.

Abundance of Breeding Pairs and Juveniles

In 2019, aerial surveys to estimate abundance of breeding pairs with and without nests were conducted from May 20-24 using methods described in Johns (2010). This year, we also tested new methods to detect whooping crane nests using analysis of high-resolution satellite imagery collected during the aerial survey. Using these methods, we detected 97 nests (Table 1, Figure 2), 94 of which were detected during the aerial survey and three via analysis of satellite imagery. We also detected 28-29 pairs without nests; this range reflects the possible number of unique pairs without nests because most cranes are not individually banded yet may move during the duration of the survey. Of the 97 nests, 22 were outside the area designated as containing CH and 11 were outside WBNP. Of the 11 nests outside WBNP, where CH has not yet been identified, all were north of the Nyarling River. Nests were not detected on Salt River First Nation reserve lands (i.e., Lobstick Creek) east of WBNP where up to two nesting pairs have been found in recent years. In 2019, breeding pair surveys were conducted by John Conkin (CWS; May 20-24), Lori Parker (PCA; May 20-24), Sharon Irwin (PCA; May 20-23), and Hannah Edwards (Calgary Zoo (CZ); May 24) over 23.1 hours using an EC-120 helicopter piloted by Felix Erner of Phoenix Heli-flight (Fort McMurray, AB).

Aerial surveys to estimate abundance of juveniles were conducted from July 27-30, 2019. Observers detected 37 juveniles in 36 family groups and 60-63 pairs without juveniles (Table 1). Of the 36 family groups, 34 were pairs with one juvenile, one was a pair with two juveniles, and one included a single adult with one juvenile. Using information collected during the breeding pair and juvenile surveys, we determined that annual productivity was 0.38 juveniles per nest, below the 20-year average of 0.49 but within the long term natural range of variation of about 0.20 to 0.80 (Figure 3). In 2019, juvenile surveys were conducted by John Conkin (CWS; July 27-30), Lori Parker (PCA; July 27-30), Hannah Edwards (CZ; July 27-28), and Sharon Irwin (PCA; July 29-30) over 20.4 hours using an EC-120 helicopter piloted by Felix Erner of Phoenix Heli-flight.

Effects of Predation and Weather on Whooping Crane Nest Success

Starting in 2019, we initiated a project designed to evaluate nest success of AWBP cranes and identify factors that may limit nest success, using remote cameras with time-lapse surveillance, acoustic recorder units (ARUs) and water level gauges at nest sites. This project represents a multi-agency effort between CWS, PCA, USFWS and CZ. Specific objectives are to (1) determine nest failure and success rates; (2) determine and quantify causes of nest failure (e.g., predation, weather) and associations with reproductive behaviour (e.g., incubation); 3) evaluate the impacts of variation in nest survival on recruitment rates and population growth.

Deployment of monitoring equipment at nest sites follow protocols developed at the Necedah National Wildlife Refuge (NNWR) where 50 whooping crane nests of the Eastern Migratory Population of whooping cranes were monitored with remote cameras since 2015.

Their work indicates that whooping cranes are not disturbed when cameras are mounted according to the following conditions. Monitoring equipment, mounted on T posts, are placed between 6-13m from the nest, with placement capitalizing on local vegetation to disguise the equipment and break up its silhouette on the horizon.

Activities under this project are conducted under three phases: a pre-pilot (conducted during 2019), pilot (planned for 2020), and full study (anticipatory start in 2021). During the pre-pilot in 2019, we deployed monitoring equipment at 11 inactive nest sites to evaluate logistic concerns (e.g., confirm that it is feasible to efficiently deploy equipment under marshy conditions in WBNP) and to determine if monitoring equipment attracts predators. Because the area surrounding a nest is likely to have some background rate of predator activity (e.g., ravens perching on vegetation, or mammalian predators behaving normally in their territories), we divided the sample of 11 inactive nests into two categories: treatment sites (N=5) with cameras and ARUs deployed at 50m ("distant post") and cameras at 6-13m ("near post") from nests, and control sites (N=6) with cameras and ARUs deployed at distant posts only, per protocols developed at NNWR. Our objective was to use images and audio recordings from distant posts to quantify a background rate of predator activity at control sites and compare this to predator activity at treatment sites (i.e., to determine if the deployment of cameras and other gear 6-13m from nests alters predator activity at the nest). Distant posts were considered far enough to reduce any influence they may have on any predator reactions to equipment at the near post, while being close enough to (a) capture images in which predators of whooping crane nests and other species of animals would be visible at the near post and (b) record calls of common ravens, the most abundant predator of whooping crane eggs whose presence can be detected through audio cues, in the general area.

Remote cameras were programmed to record images at 30-second intervals and collected 164,826.4 ± 45,537.0 images per camera (mean ± standard; range: 39,997-185,853) over 57.1 ± 15.9 days (range: 13-65 days). Detection of species known to predate whooping cranes or their nests were rare in images (single detections for black bear and common raven), so we used generalized linear models to estimate abundance of all species of animals (as a proxy for predator activity) at treatments and controls. Total counts were significantly higher at control sites than treatment sites (GLM coefficient: -0.80, 95% confidence interval: -1.08 - -0.54). This result is not consistent with the hypothesis that deployment of cameras and other gear near whooping crane nests attracts predators or other animals to the nests, in fact it suggests the opposite may be the case. Although our sample size was limited and the magnitude of the response could vary with more data, the direction of the response is not likely to be different so we conclude that animals are, in fact, not attracted to equipment that we propose to deploy at active whooping crane nests starting in 2020.

In addition to analysis of camera images, we sampled audio recordings collected by ARUs at distant posts to assess differences in common raven activity between treatment and control sites. For each site, three-minute audio recordings were transcribed 18 times throughout the day beginning one hour before sunrise to 0.5 hours after sunset over 13.6 ± 2.2 days (mean ± standard deviation; range: 11-17) for a total of 115.1 ± 17.4 recordings per site (range: 78-136). For each treatment or control site, we computed the proportion of recordings in which common ravens were detected. Then, for treatment and control groups, we used the site-specific proportions to compute the average proportion of recordings with raven detections which did not differ between treatment (0.11 ± 0.05) and control (0.11 ± 0.08) sites, providing additional support for our conclusion that activity of whooping crane predators is not higher at treatment

sites than at control sites. Given our conclusion from the 2019 pre-pilot study that deployment of cameras and other gear near whooping crane nests does not increase predator activity at nest sites, we propose to conduct pilot work in 2020 with remote cameras and other monitoring equipment placed 6-13m from up to 10 active whooping crane nests. Objectives of the pilot phase are to ensure that deployment and operation of cameras does not negatively affect nesting activities of cranes (i.e., via heightened anxiety at the nest or nest abandonment) and that operation of cameras captures adequate imagery to measure nest success or failure from predation or flooding events. If the pilot phase is successful, we will initiate the full study in 2021. Again, monitoring equipment will be placed 6-13m from nests, and sample sizes will depend on logistics, costs and power analyses based on pilot data. Given the binary nature of the data, it is likely that sample size requirements will be ~40-60 active nests (10-20/year for up to three years).

Monitoring equipment was deployed May 25-27 by Mark Bidwell and John Conkin (CWS), Wade Harrell (USFWS), Hannah Edwards (CZ), Sharon Irwin and Lori Parker (PCA) using an AS350B2 helicopter piloted by Steve Tomlinson of Phoenix Heli-flight. Equipment was retrieved July 29-30 by Mark Bidwell (CWS), Grant Harris (USFWS), and Hannah Edwards (CZ), using an AS350B2 helicopter flown by Paul Spring of Phoenix Heli-flight.

Capture and Banding of Fledged Juveniles

In 2009, a multi-agency, collaborative research and monitoring project to capture and mark whooping cranes was initiated to monitor movement, behaviour, and survival of cranes during all aspects of their annual cycle. That project, which continued through 2016, was carried out by the Whooping Crane Tracking Partnership (WCTP, Phase 1), a cooperative effort between five core partners: CWS, USGS, USFWS, the Crane Trust and Platte River Recovery Implementation Program, with additional support from PCA, the International Crane Foundation (ICF), and the Gulf Coast Bird Observatory. Specific objectives were to: 1) advance knowledge of breeding, wintering, and migration ecology including threats to survival and population persistence; 2) disseminate research findings in reports, presentations, and peer-reviewed literature to provide reliable scientific knowledge for conservation, management, and recovery of whooping cranes; and 3) minimize negative effects of research activities to whooping cranes.

During Phase 1 of the WCTP, captured birds were fitted with a GPS/PTT (Global Positioning System/Platform Transmitting Terminal) satellite transmitter and unique colour leg bands. Transmitters were programmed to record each bird's spatial location four times daily, recording both daytime and nighttime locations throughout the annual cycle. From December 2009 to February 2014, 68 whooping cranes were captured and marked with transmitters; 37 adults and two juveniles were marked on the Texas Gulf Coast wintering grounds and 31 juveniles were marked during the breeding season in WBNP. Transmitters are expected to function for three to five years but the number and frequency of GPS transmissions declines over time. By 2018, most transmitters were offline, but during the migrations of spring and fall, 2018, three and one cranes, respectively, marked with PTT transmitters provided telemetry data. For additional information on this project, see USGS (2016).

Beginning in 2017, a renewed effort was made to capture whooping cranes and mark them with GPS tracking devices. This work is Phase 2 of the WCTP, which consists of four core partners, CWS, PCA, USFWS, and USGS, with additional support from ICF, CZ and the Joint Canada-Alberta Oil Sands Monitoring Program. Data collected through this project will build on existing baseline monitoring conducted via satellite telemetry since 2010 and will be used to

investigate potential risk to whooping cranes from industrial development (e.g., extraction of oil and gas, mining, and wind power). During Phase 2, captured birds are fitted with GPS/GSM (GPS/Global System for Mobile Communication) transmitters with Global Positioning System capabilities and colour leg bands. For most areas, GPS/GSM transmitters were programmed to collect up to 48 GPS locations daily at equal time intervals and to upload location data to the GSM system every 24 hours. This data acquisition schedule allows for highly detailed information on diurnal and nocturnal (roosting) habitat use during all stages of the annual cycle, and on migratory behaviour in spring and fall. Beginning in 2019, more frequent GPS location collections (up to 1440 locations daily) are programmed for certain areas (e.g., the oil sands region of Northern Alberta and in proximity to wind farms in U.S.) to allow extremely fine-scale tracking of movement and habitat use through these specific areas of interest. In 2017, CWS and WCTP partners marked 10 juvenile whooping cranes during the breeding season in WBNP and in the winters of 2017-18 and 2018-19, USFWS and WCTP partners marked 19 adults on the Texas Gulf Coast.

In August 2019, CWS and WTCP partners again marked juveniles in and around WBNP. Family groups with young suitable for capture were located during juvenile fledging success surveys. During capture attempts, the helicopter circled to find a suitable landing spot to position the capture crew on the ground (typically 200-300 meters from the family group). The ground team consisted of Mark Bidwell (CWS), John Conkin (CWS), David Brant (USGS), and Dr. Barry Hartup, DVM (ICF); an observer (Lori Parker (PCA; Aug 01), Sharon Irwin (PCA; Aug 02, 04) and Rhona Kindopp (PCA; Aug 03)) remained in the helicopter to provide direction to the ground team via radio. With the ground crew in place, the helicopter positioned itself with the crane family directly between it and the capture crew, moving as necessary to provide an aerial target to guide the ground crew's approach towards the juvenile to be captured (family groups are often not visible through dense, tall vegetation). Radio contact between the helicopter and the ground crew facilitated coordination during capture attempts. Family groups did not appear stressed by the presences of the helicopter and typically walked away, often stopping to feed or preen. Once the ground crew became visible, adults typically flushed. Crane juveniles typically responded to the presence of the ground crew by seeking nearby cover or by fleeing (the latter response rendering them unavailable for capture); how the juvenile would respond was generally apparent within a few moments of the parent's retreat.

On August 01-04, 20 fledged whooping crane juveniles were captured in 22 attempts with an average handling time (i.e., from capture to release) of 19 minutes. Nineteen captured cranes were banded and fitted with a satellite transmitter; one captured crane was released without being marked with bands or transmitter as its weight was below the marking threshold identified in our Animal Use Protocol. For all marked cranes, blood and feather samples were collected and basic biometric measurements (culmen, wing chord, tarsus, and weight) were taken. Finally, Dr. Hartup performed a general assessment of the health of each bird before it was released. Capture activities were conducted over 19.4 hours using an AS350B2 helicopter operated by Paul Spring of Phoenix Heli-flight.

Monitoring of Marked Whooping Cranes and Juvenile Survival during the Period of Fall Migration from the Breeding Grounds to Saskatchewan

In 2019, 51 individual whooping cranes marked with colour leg bands were re-sighted: 12 during nesting surveys in May, 11 during fledging surveys in July, and 42 during ground-based staging surveys in September-November in Saskatchewan. Data are used to estimate

apparent juvenile survival during the period of fall migration from the breeding grounds to Saskatchewan. Of 16 banded family groups observed in July and later observed in September-November, 14 were re-sighted with juveniles so apparent juvenile survival during this period was 87.5%, consistent with results obtained since 2012 (Table 2).

Management Considerations

We confirmed nesting by 97 pairs in late spring, producing an average of 0.38 juveniles per nest by mid-summer. While the number of confirmed nests has increased steadily since surveys began in 1966, it also varies annually (Figure 3) possibly in response to environmental conditions during the breeding season. The ratio of juveniles to nests, which is an estimate of breeding success for the population, also varies annually (Figure 3) in response to environmental conditions but also in a periodic manner that tracks the 10-year boreal hare-lynx cycle (Boyce et al. 2005) likely because of periodicity in abundance of predators (e.g., wolves, lynx, red fox).

The four highest annual nest counts have occurred during the past six years, highlighting the gradual but steady increase in the breeding population over the last 60 years (Figure 3). Even so, the AWBP is many years away from achieving the Canadian down-listing goal of 250 pairs (COSEWIC 2010). Recovery of the species currently depends on growth of the AWBP, so monitoring should continue until recovery goals are reached (CWS & USFWS 2007). Twenty-two breeding pairs were detected outside the area designated as CH (Environment Canada 2007) under SARA, and 11 of these were also outside WBNP, representing the highest values for these metrics and emphasizing the ongoing expansion of the AWBP's breeding range. The first nest outside WBNP was detected in 1982 on reserve lands of the Salt River First Nation, east of WBNP, and in 1998 cranes were detected nesting north of WBNP, in the Northwest Territories. Up to 23% of nests and 38% of the nesting range occur outside CH annually, as defined in the current recovery strategy. Although cranes and their nests are protected under SARA and the *Migratory Birds Convention Act* wherever they occur, breeding habitat is not formally protected under federal legislation unless it is identified as CH. In particular, SARA prohibits destruction of CH in federal protected areas (e.g., WBNP) and includes measures that could protect CH in other areas. Moreover, up to 11% of nests occur outside WBNP annually, and these nests and associated habitat are not protected under the *Canada National Parks Act* or related regulations. Because the breeding range of whooping cranes has expanded outside the CH into areas that could be impacted by human development, ECCC supports efforts to update CH identification to ensure it more closely corresponds to current and probable future breeding ranges of the species.

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NR-2019-NT-002, Environment and Climate Change Canada Western & Northern Animal Care Committee Permit 19MB01, Northwest Territories Wildlife Care Committee Protocol NWTWCC 2019-010, Northwest Territories Wildlife Research Permit WL500726, and Parks Canada Agency Research and Collection Permit WB-2019-31922.

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Table 1. The number and type of observations of whooping cranes that were detected during breeding pair and juvenile surveys in May and July 2019, respectively.

Observation type	May	July
Nests	97	n/a
Adults on or near nests	131	n/a
Pairs without nests	28-29	n/a
Pairs with juveniles	n/a	36*
Juveniles	n/a	37
Pairs without juveniles	n/a	60-63
Lone cranes	52	20-21
Grouped cranes	0	3
Total cranes	239-241	251-258

Notes:

* One adult without a mate was observed with one young.

(i) Because cranes may move over the duration of the survey, ranges reflect the possible number of unique individuals or unique pairs. The main objectives of the surveys are to obtain estimates of (a) nests and (b) pairs with juveniles, which are reported with more precision.

(ii) Many lone cranes observed in May are likely mates of adults detected on nests.

(iii) Grouped cranes refer to three or more cranes at one location. In 2019, the maximum number of adults observed at one location was three.

Table 2. Apparent survival of juvenile whooping cranes during the period of fall migration from the breeding grounds to Saskatchewan, 2012 to 2019.

Year	Juveniles of banded families detected on breeding grounds	Juveniles of banded families re-sighted during fall	Banded families re-sighted without young	Banded families not re-sighted during fall	Apparent juvenile survival
2012	8	8	0	0	100
2013	7	5	0	0	100
2014	14	12	0	0	100
2015	11	9	1	1	90
2016	13	11	0	2	100
2017	16	8	2	6	80
2018	5	3	0	2	100
2019	25	14	2	9	87.5

Figure 1. The amount of the whooping crane nesting area burned by wildfire annually (left vertical axis, dashed red line represents 25-year mean), and the total precipitation recorded at Fort Smith, Northwest Territories before (October-April) and during (May-September) the breeding season (right vertical axis, dashed blue lines represent 60-year means), 1959 to 2019.

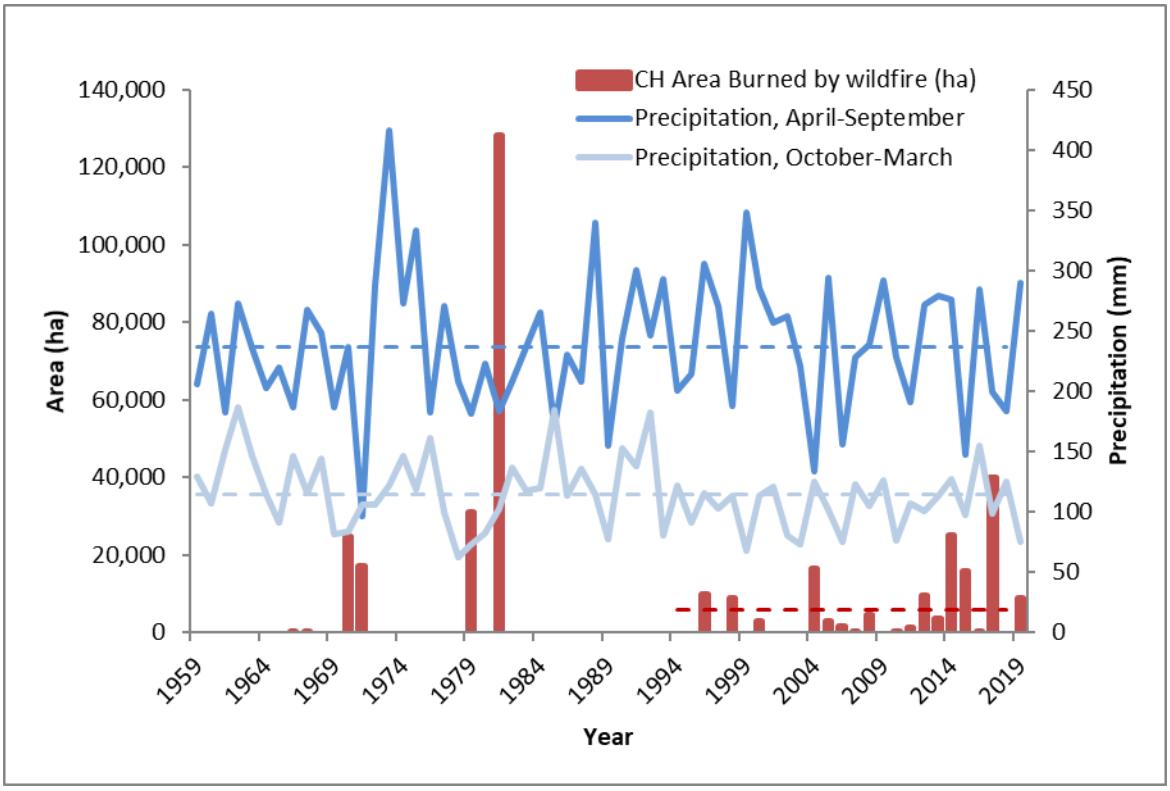


Figure 2. The density per 100 km^2 of whooping crane pairs, with and without nests, detected during the breeding pair survey in May 2019.

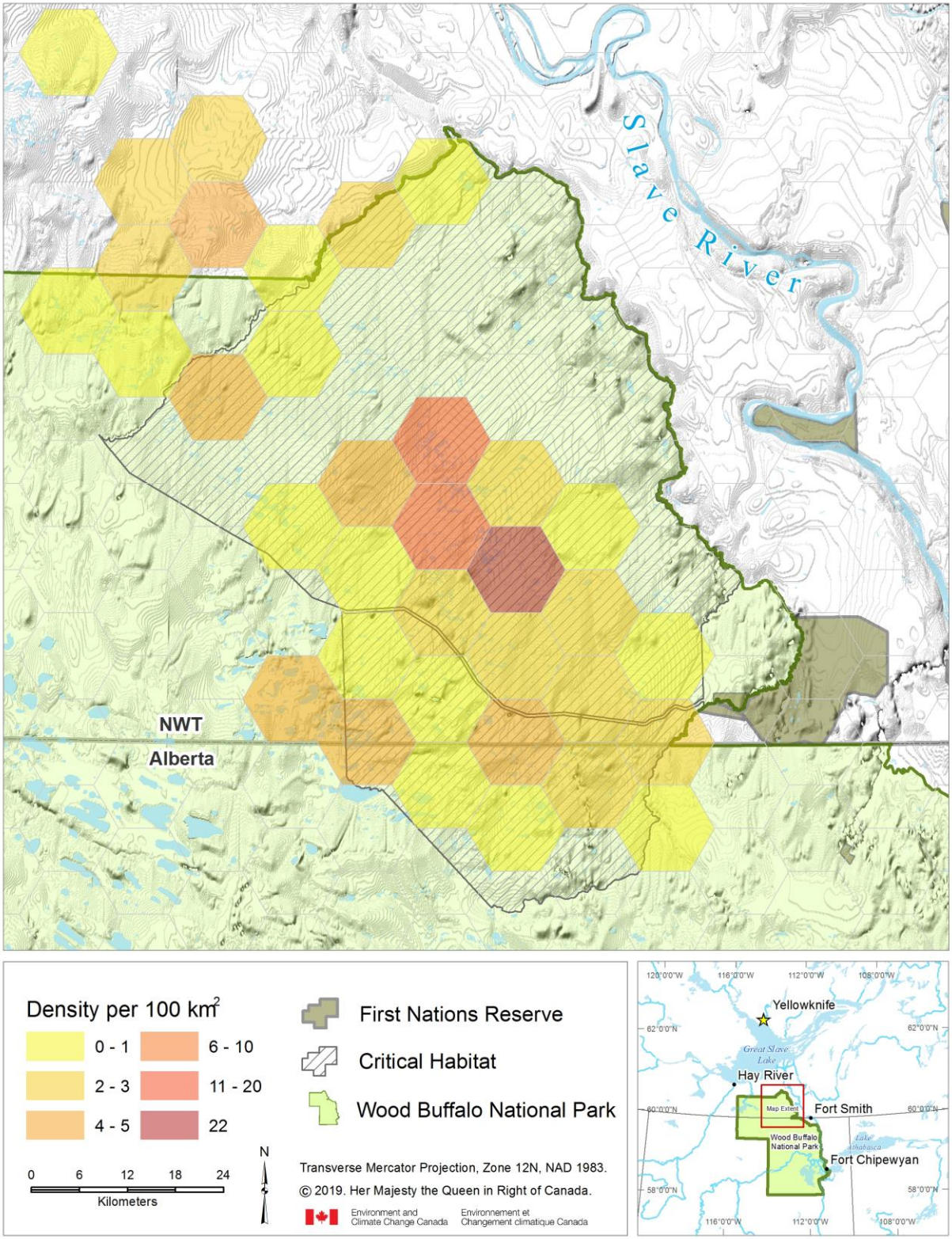
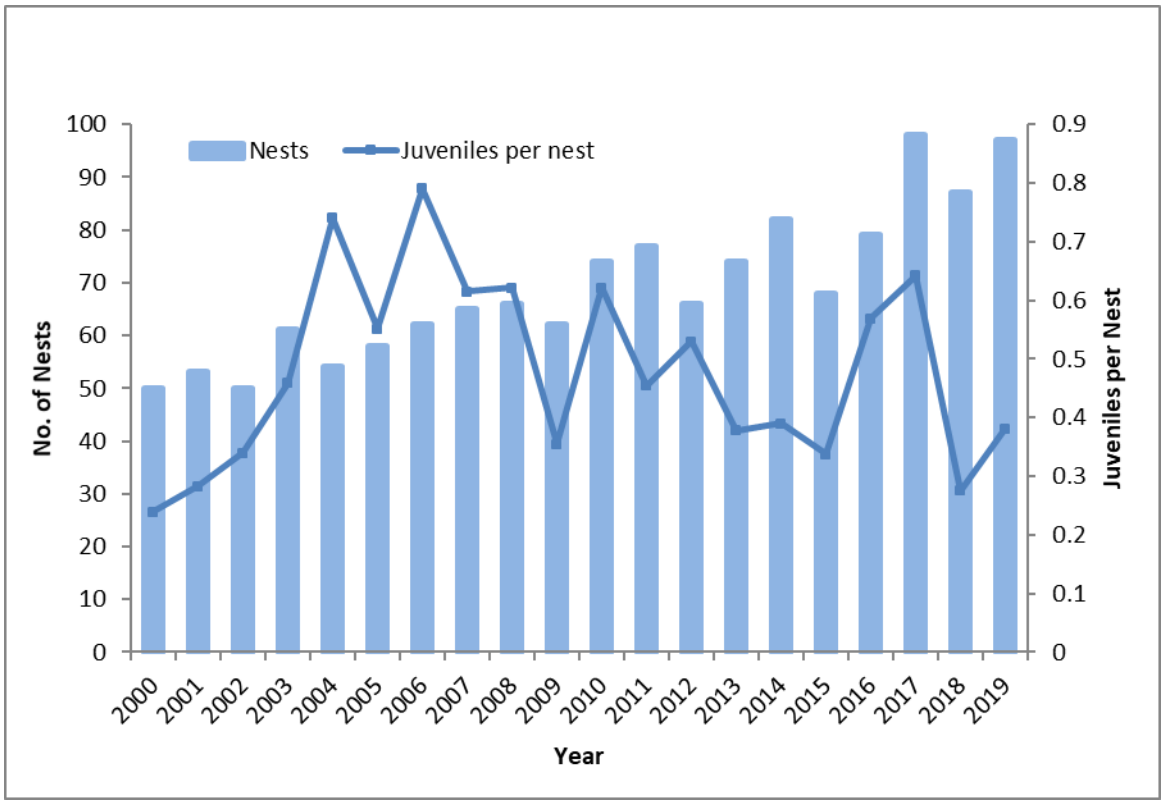


Figure 3. The number of whooping crane nests, and juveniles per nest, detected during aerial surveys from 2000-2019. The number of nests and juveniles are estimated during breeding pair (May) and juvenile (July-August) surveys, respectively; the number of juveniles per nest is calculated using information from both surveys.



Appendix A. List of Acronyms used in this report.

Acronym	Description
AWBP	Aransas-Wood Buffalo Population
CH	Critical Habitat
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
CZ	Calgary Zoo
ECCC	Environment and Climate Change Canada
GPS	Global Positioning System
GSM	Global System for Mobile communication
ICF	International Crane Foundation
IRP	US-Canada International Recovery Plan
NNWR	Necedah National Wildlife Refuge
PCA	Parks Canada Agency
RS	Recovery Strategy for the Whooping Crane in Canada
SARA	Species at Risk Act
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WBNP	Wood Buffalo National Park

2019-2020 Louisiana Whooping Crane Report

Louisiana Department of Wildlife and Fisheries

Coastal and Nongame Resources

1 July 2019 through 30 June 2020

EXECUTIVE SUMMARY

Eleven juvenile Whooping Cranes were received in November 2019 from the Freeport-McMoRan Audubon Species Survival Center (ASSC) in New Orleans, Louisiana. They were transported to the White Lake Wetlands Conservation Area (WLWCA) in Vermilion Parish where they were temporarily held in a top-netted pen before being released. Nine survived through the end of the report period. Additionally, one of six known chicks hatched in the wild in 2020 fledged and survived through the end of the report period. The COVID-19 pandemic impacted our ability to track and monitor cranes in remote locations, and it's likely that some nests, and possibly some chicks, went undocumented.

The maximum size of the Louisiana non-migratory population at the end of the report period was 76 individuals (39 males, 36 females, and one unknown), with 68 birds located in Louisiana, seven in Texas, and one in Oklahoma. Based on location data generated via remote transmitters, we documented cranes in 15 parishes throughout Louisiana, with three of those parishes accounting for 87% of the data points within the state. Similar to previous years, a number of Louisiana Whooping Cranes used areas in Texas, mainly in the southeast, with nearly 17% of the data points collected during the report period located there. One crane was also documented using six additional states. In 2020, a pair nested for the first time in Texas after pairing and establishing a territory there the previous year. It is likely that pair will remain and continue to nest in Texas in future years.

During the 2020 breeding season, 12 nesting pairs initiated 22 nests in seven different parishes in Louisiana and one county in southeast Texas. It is likely that several additional pairs nested, but those nests and any resulting chicks were not able to be documented due to their remote and inaccessible locations and restrictions related to the COVID-19 pandemic. Nine pairs consisted of individuals who each had previous nesting experience while three pairs nested for the first time. Seventeen nests from seven pairs were located on private property in actively fished crawfish fields, while the remaining five nests from five pairs were located in marsh habitats - one pair nested in the WLWCA marsh and four nested in marsh habitat on private property.

In 2020, six chicks hatched naturally to five pairs, two of whom had previous parenting experience, while the remaining three were first time parents. One chick survived and fledged at 84 days of age to experienced parents, who have now fledged five chicks between them since 2016. The remaining chicks disappeared at ~11-41 days of age and are presumed dead. Due to ongoing, significant embryo mortality, we continued submitting adult blood and egg content samples for heavy metal and toxicology screening. The COVID-19 pandemic limited our ability to perform egg manipulations for data-logging egg deployments and egg swaps, although we were able to deploy a few data-logging eggs early in the nesting season. Additionally, restrictions at the captive breeding centers significantly impacted their ability to hatch and rear chicks for release, resulting in no juvenile cranes available for release into the population in the fall of 2020. Although the future is uncertain due to the ongoing pandemic, we do plan to continue with research initiatives to the extent possible in future years while adherring to any regulations or restictions captive centers have in place.

The Louisiana Department of Wildlife and Fisheries (LDWF) continues to educate the public about the Whooping Crane reintroduction program through a variety of means including a new display that will travel to libraries across the state.

Our media campaign continued to focus on raising public awareness regarding both positive and negative aspects of the program, including re-emphasizing the issue around illegal shootings involving Whooping Cranes which accounts for almost 30% of the mortality in the population where a cause of death could be determined. The media plan once again utilized an assortment of methods including billboards, television, and radio advertisements.

Now in its tenth year, the Louisiana Whooping Crane reintroduction has made much positive progress but still has challenges to overcome. We are determined to continue making strides towards our ultimate goal of establishing a self-sustaining population in the state.

RECENT COHORT SUMMARIES, PEN MANAGEMENT, AND RELEASE

2019 Cohort Arrival and Release Summary

On 12 November 2019, 11 juvenile cranes (3 females, 8 males) were received for release in southwest Louisiana at the White Lake Wetlands Conservation Area (WLWCA). Seven of the cranes were costume-reared in captivity at the International Crane Foundation in Baraboo, Wisconsin and flown to the Freeport McMoRan Audubon Species Survival Center (ASSC) in New Orleans on 3 October where they joined four cranes (1 parent-reared, 3 costume-reared) that had been hatched and reared at the center. Upon arrival at ASSC, female L7-19 was found with significant lameness in her left leg and it was later determined she had a left proximal lateral tibiotarsus fracture. Due to several factors, including the difficulty of a surgical repair, the decision was made to allow the injury to heal on its own. Since the injury appeared to have healed and the juveniles are initially held in a top-netted pen the decision was made to transfer her along with the rest of her cohort. This way her ability to move around in the marsh could be evaluated while still in a contained and controlled evironment. Upon arrival at WLWCA, the cranes were immediately examined by a wildlife veterinarian, banded with a numbered metal band and a unique combination of colored plastic leg bands, and fitted with one or two leg-mounted tracking devices before being transported by boat to the release area and placed in the top-netted section of the release pen. During this time, the cranes were routinely monitored by costumed staff and provided supplemental food. L7-19 was observed to have a very mild limp for the first few days after being released into the top-netted section of the release pen, but this resolved prior to being released.

The juvenile cranes were released from the top-netted section of the pen on 25 November at which time they had access to the open portion of the pen and the surrounding marsh. After release, L9-19's left leg was observed hanging down while in flight. This bird had a large nodule on the medial left hock prior to arrival at WLWCA and although the cause was unknown, it was not thought to be of concern. He did not show any impairment while walking, flying, or landing but the long term impact of the nodule and drooping leg is uncertain. A trio of older cranes began spending time around the pen site shortly after the juveniles arrived and were territorial of the feeders and highly aggressive towards the younger cranes upon their release. Despite our attempts to manipulate food availability, including the removal and addition of feeders, the older cranes remained near the pen and continued to harass the juveniles. Additionally, these adults would force the juveniles into the shrubs on the levee adjacent to the blinds where they would remain rather than dispersing further into the marsh, which was problematic because they were more susceptible to predation on the levee. Despite supplemental food still being available, though often guarded by the adults, the juveniles left the release pen by 7 and 8 December and all feeders were removed from the pen site on 15 December. Although they were no longer present near the pen, the juveniles remained on WLWCA leased agricultural property and were frequently seen near or associating with a minimum of 15 different adults through at least 30 March. In early March, they made a one day flight north and east through five parishes before returning to the WLWCA, and in late May, at least 3 (but up to 6) traveled briefly into eastern Texas. During that trip, female L2-19 separated from the group and settled in Jefferson Davis Parish for the remainder of the report period, while the others returned to the WLWCA.

DISTRIBUTION

Whooping Cranes were monitored via remote tracking devices and in real time via very high frequency (VHF) transmitters in order to record movements, assess behaviors indicative of nesting and molting, and document the general health of the population. Remote monitoring was accomplished using two types of GPS transmitters developed by Microwave Telemetry, Inc.: 22-g solar Argos/GPS platform transmitter terminals (PTT) and 25-g solar Global System for Mobile Communications/GPS transmitters (GSM). The PTTs are programmed to collect data three times per day (06:00, 14:00, and 22:00 GMT) and transmit data every 48 hours. The GSM transmitters collect numerous location points throughout the day and transmit data whenever cranes are within range of cell towers. This results in significantly larger amounts of location data for birds with GSM transmitters compared to those with PTTs. Therefore, to make the database of GPS locations more manageable and comparable, we reduced the overall number of GSM points analyzed by including only the points that match those collected via PTTs as closely as possible in the dataset. At times, GPS data from PTTs are unavailable (i.e., low battery power), but Doppler readings that indicate location are still transmitted. Only high-quality Doppler readings are included in the distribution analysis but these account for only 0.01% of the location data.

Remote tracking devices transmitted just over 35,500 data points between 1 July 2019 and 30 June 2020. Of these, 69.8% were located in three parishes in Louisiana and 11.9% were located in two counties in Texas (Table 1; Fig. 1, 2, 3). Another 10.5% were distributed across 12 additional parishes in Louisiana, and 5.0% were distributed across 10 additional

counties in Texas. The remaining 2.8% were located in other states and all points outside of Louisiana and Texas were from one individual, female L4-17.

Use of Out-of-State Locations

Six individuals from the Louisiana population were documented (via remote transmitter data or visual observations) using areas over 325 kilometers from release areas in Vermilion and Cameron parishes (Table 2). Migrating cranes can typically fly an average of 400 kilometers during a single migration day, so a distance of 325 kilometers represents approximately a one-day flight. Five of these individuals hatched in 2018, and the remaining individual, female L4-17, has spent most of her time outside this zone since her release in November 2017. Although mostly solitary since her release, L4-17 winters with other cranes at the Wheeler NWR in Alabama where thousands of Sandhill Cranes and as many as 20 eastern migratory population Whooping Cranes also spend the winter.

MOLTING

In 2020, molting was confirmed in four individuals: L12-16 & L13-16 (four-year-old males), and L2-15 & LFW12-15 (five-year-old male & female, respectively). We suspect a number of other cranes also may have molted during the report period based on extended periods of limited movement during the spring and summer when molting takes place. These include: L14-16, L25-16, L13-17 and L13-18.

Additionally, L1-13 was confirmed to have molted in 2019 based on photos taken in 2020 showing him with new flight feathers. Molting for LF1-98, previously suspected in 2019, was also later confirmed from observations.

CAPTURES

Five captures of released cranes were made on 11 days of attempts from 17 October 2019 – 3 March 2020. Three captures were hand grabs and two were via a leg noose. One additional crane was initially caught in the leg noose before an equipment failure, which caused her to escape prior to being under control. All captures were for the purpose of banding or transmitter replacement. More information can found in Table 3.

PAIRING AND REPRODUCTION

A total of 22 nests by 12 pairs were confirmed in seven parishes (Acadia, Allen, Avoyelles, Calcasieu, Cameron, Jefferson Davis and Vermilion) in central and southwestern Louisiana and one county (Chambers) in southeast Texas in 2020 (Fig. 4), the seventh year of nesting by the Louisiana flock. Nine pairs consisted of individuals who each had previous nesting experience and three pairs were nesting for the first time. Seventeen nests from seven pairs were located on private property in actively fished crawfish fields, while the remaining five nests from five pairs were located in marsh habitats – one pair nested in the WLWCA marsh and four nested in marsh habitat on private property. Of the four nest attempts in private marsh, three were in close proximity to WLWCA. Due to a number of failed remote transmitters and pairs that became “untrackable” along with a moratorium on tracking flights due to the COVID-19 pandemic, nesting in the remote WLWCA hunting marsh was unable to be documented, although we suspect at least two additional pairs likely had at least one attempt each. The status of one of those pairs was unknown for a total of 133 days and it is possible that they were raising a chick during that time, however they were later observed out of the marsh with no offspring. We also suspect one pair with a documented first nest likely renested, based on an observation of the male in flight alone; however, that potential renest was unable to be visually confirmed and neither bird had a functional remote transmitter, which would have helped determine if a renest attempt was made. First nesting attempts were initiated in February (8-9), March (2-3) and April (1). Re-nesting attempts were initiated an estimated average of 17 days after the first nest attempt was completed and occurred during March (2) and April (2). Third nesting attempts occurred in April (1) and May (1), one fourth attempt and one fifth attempt were likely initiated in April and a sixth and seventh attempt were initiated in May.

A minimum of 31 eggs were produced in 2020, 30 confirmed by visual observation or discovery of eggshells and one not directly observed but presumed due to a mated pair sitting on a nest platform for just over one week. Thirteen eggs were

confirmed fertile, of which seven died prior to hatch (1 early dead, 2 mid-dead, 4 late dead) and six successfully hatched in the wild. Nine other intact eggs were collected and determined to be non-viable and the remaining nine eggs were of unknown fertility and viability, with most of these disappearing or breaking at the nest.

Of the 22 confirmed nests, five were incubated to full term or beyond with no hatch, eight were abandoned prior to full term for unknown reasons, five successfully hatched six chicks, and the remaining three had an unknown outcome (two may have incubated to or past full term). An eggshell membrane was found at one of the nests classified as an unknown outcome, and appeared to possibly have resulted from a hatched egg; however, there was no other evidence of a chick and the length of incubation was not definitely known.

In 2020 we documented unusual nesting behavior from one experienced pair who hatched chicks the previous two years. Female L5-14 and mate, L12-16, initiated their first nest on 2 February (11 days earlier than in 2019) and incubated past full term on eggs that were not viable. After the failure of their first attempt, they initiated four additional nests, all of which contained a single egg that they only minimally incubated or abandoned almost immediately for unknown reasons. Two of these platforms were significantly smaller than a normal-sized nest and the other two were only discovered later, after they deteriorated so accurate measurements were not obtained. A sixth nest attempt appeared to be normal but was abandoned after a week, possibly due to a severe storm that produced hail and may have caused one of the eggs to break. A seventh attempt was made but again failed after about one week and was never visually confirmed while active. GPS data for the male indicated incubation behavior and a disintegrated platform was found five days after failure, at which time male L12-16 was suspected to be in molt (later confirmed). It is unknown if this may have contributed to the failure of their last attempt.

Summary of breeding history by pair from 2014-2020 is displayed in Table 4, and complete nesting histories can be found in Appendix A.

Pair Information

Pair, as used in this section, refers to consistent association between a male and a female that were observed copulating, nest building, or were together mainly exclusive of other individuals for at least 30 days. Pairs that both formed and nested during the report period are indicated by an asterisk (*).

Formed:
L10-17/L13-17, May 2019
L8-15/L1-17, June 2019
L23-16/L11-15*, September
L17-16/L17-17, December
L21-17/LW3-18, January
LW1-18/L9-18, January
LF1-98/L10-18, February
L16-16/L26-16*, March
L9-16/L15-17, April/May
L25-16/L13-17, April/May
L8-15/L17-16, May/June

Dissolved:
L15-17/L23-17, August
L26-16/L8-17, March
L6-13/L16-16, March
L12-17/L20-17, March/April
L10-17/L13-17, April/May
L17-16/L17-17, April/May
L8-15/L1-17, May, disappearance of male

In addition to the twelve pairs who laid eggs in 2020, one other pair (L21-17/LW3-18) was observed building a nest platform in Acadia Parish but did not lay eggs.

Current Population Structure
The population contained a maximum of 76 individuals as of 30 June 2020.

Confirmed breeding pairs (i.e., have produced eggs): 15
L2-11/L13-11, L3-11/L1-13, L7-11/L11-17, L11-11/L8-13, L2-12/L3-14, L3-13/L8-14, L5-14/L12-16, L7-14/L2-15, L13-14/L6-15, L10-15/L19-16, L11-15/L23-16, L6-16/L16-17, L8-16/L22-17, L13-16/L14-16, L16-16/L26-16

Pairs that built nest platforms in 2020: 1
L21-17/LW3-18

Subadult or newly formed pairs: 9
LF1-98/L10-18, L6-13/23-17, L8-15/L17-16, L9-16/L15-17, L17-17/L5-18, L24-16/L14-17, L25-16/L13-17, LW3-17/L2-17, LW1-18/L9-18

Currently unpaired adult males: 5
L9-17, L20-17, L1-18, L6-18, L13-18

Currently unpaired adult females: 9
L1-12, LFW12-15, L4-17, L8-17, L10-17, L12-17, L2-18, L7-18, L12-18

Missing and/or suspected dead: 2
1-17, 3-17

Yearlings (HY2019): 8 males, 1 female

Wild-hatched: 1 unknown

Nest Monitoring
Known and potential breeding pairs were monitored more frequently, primarily through transmitter data, for signs of nest initiation beginning in late January. Once a nest was confirmed, it was monitored for its duration and if the eggs failed to hatch, they were collected and examined to determine fertility. Monitoring consisted of review of remote transmitter data several times a week, supplemented with ground or aerial observations (prior to the COVID-19 pandemic restrictions) approximately once a week for nests that were in accessible locations. Some observations were obtained by landowners or cooperators in the area.

Early in the reintroduction, field staff conducted three-hour nest monitoring sessions at various stages of the incubation period to collect data on incubation behavior. Over time, as more pairs began nesting, we supplemented field monitoring efforts through the use of trail cameras deployed near the nest and reduced the number of human-monitoring sessions. We conducted a single three-hour nest-monitoring session in 2020, and plan to only conduct them on a small sample of nests in the future (i.e., the first nest of a new pair). We did, however, deploy trail cameras at a few nests in 2020 (see below) and will continue to rely on this form of monitoring as it has proven to be an effective way to collect data on incubation behavior.

Camera Deployments
For the fifth year in a row, trail cameras were deployed near a subset of nests to help supplement nest-monitoring efforts. Cameras, programmed to photograph the nest every minute, were deployed at five different nests 5-19 days into the incubation period (avg. = 11.8 days). One additional deployment was made on a nest at 13 days of incubation; however, the female was clearly very disturbed by the presence of the camera and would not return to the nest. The male appeared less effected and returned to the nest briefly to incubate but the female's behavior likely caused the male to stop incubating. The camera was removed and the cranes then resumed normal incubation. Cursory review of camera data continues to show that Louisiana Whooping Cranes tend to exhibit appropriate nest attendance and incubation behaviors.

Use of Data-logging Eggs
Previous studies led by the Calgary Zoo have used data-logging eggs (Advanced Telemetry Systems, Inc.) to collect real-time incubation data in captive populations of Whooping Cranes. The eggs collect temperature and humidity readings, as well as the position/rotation of the egg and are constructed to mimic real Whooping Crane eggs in both weight and appearance. We continued the use of data-logging eggs in Louisiana nests in 2020 with the goal of collecting additional nest environment data that may provide insight into the high level of embryo mortality documented in Louisiana Whooping Crane eggs (Table 5). Eggs were deployed into nests at the same time trail cameras were set up, and pairs were selected based on previous tolerance of brief disturbance at their nest. Unfortunately, the use of data-logging eggs was limited due to restrictions put in place because of the coronavirus pandemic. In 2020, one experienced pair had the data-logging egg added as a third egg to their nest, while one new pair had a data-logging egg added to their single egg nest. An attempt was made to deploy a data-logging egg into a third nest but the pair did not return and resume normal incubation (likely due to the camera that was set up at the same time) so the camera and data-logging egg were removed in order to encourage the pair to return to their nest.

Experimental Nest Elevation
Since nesting began in 2014, 5% of nests (5/97) have been confirmed to have failed as a result of flooding, with three of those occurring in 2019 as a result of storms that produced heavy rainfall in isolated locations. To find out if management actions could mediate possible nest failure due to flooding, a pilot experiment was conducted in 2020 to add vegetative material to nests that were naturally constructed by select crane pairs in order to raise nests higher above the surface of the water. Although the initial plan was to elevate three nests, the restrictions in place due to the COVID-19 pandemic prevented experimentation on more than one nest. The pair selected for this experiment was chosen based on accessibility (crawfish field) and previous tolerance of a brief disturbance at their nest (deployment of a nest camera in 2019 by two people). In order to minimize overall disturbance at the nest, a data-logging egg and trail camera were deployed at the same time the nest was elevated. Louisiana Whooping Crane nests are, on average, 10.0 centimeters above the surface of the water and we doubled this height by adding hay onto the top of the nest. Although the total amount of time from the initial disturbance until biologists were back at their vehicles was only 14 minutes (~6 of those actually in the field at the nest), there were four biologists present to ensure all tasks could be completed while holding back potentially defensive adults. Even though the cranes returned close to the nest several times, the nest appearance was significantly changed, and they seemed wary. The female finally resumed incubation 61 minutes after the initial disturbance, which was double the amount of time it took them to return to their nest in 2019 when only a camera was deployed. Twelve days later, the pair hatched out a chick, but the chick only survived for 11 days before disappearing. From the time the nest was elevated until the time the chick disappeared there were no flooding rain events and camera evidence showed that the height of the nest appeared to be back to the original height five days after the artificial elevation (Fig. 5). At the time measurements were taken at the nest following its conclusion (9 days after hatch), the nest height above the surface of the water had decreased to 8.0 cm.

Toxicology Screening
In an effort to explore potential reasons for the infertility and large numbers of embryonic deaths found in Louisiana Whooping Crane eggs, we began screening adults and wild-fledged juveniles for lead and mercury in 2017 and arsenic in 2018. Additionally, in 2018 we began submitting egg content samples to the Texas A&M Veterinary Medical Diagnostic Laboratory for pesticide and herbicide screening. Thus far, all results have been within normal limits though the mercury levels for five adults were noted to be at the “high-normal” end of the range; however, the database for crane results is noted to be small. Through 2020, 50 eggs from 11 different females have been tested with only two eggs from two different females, nesting in different types of habitat, testing positive for Bifenthrin at low or trace levels in 2019. Bifenthrin is a pyrethroid insecticide that is highly toxic to aquatic organisms and is used to control populations of mosquitos and red imported fire ants. LDWF plans to discontinue the egg toxicology testing in future years due to the expense and the negative results indicating this may not be a major contributing factor in the problem of embryo death.

Chicks
In 2020, six chicks hatched to five pairs (four pairs hatched one chick and one pair hatched two chicks). All chicks hatched to their biological parents with three pairs hatching chicks for the first time (in their first or second year of nesting), while the other two pairs had previous chick rearing experience. One chick survived to fledging, which was confirmed at 84 days of age, whereas the other five chicks disappeared between 11-41 days of age. We assume one chick hatched to a pair nesting in Texas for the first time but we were unable to get a visual confirmation of the chick. We base our assumption that the chick hatched and then disappeared on our analysis of the transmitter data from both adults as well as behavioral observations made on the adults. Furthermore, it’s possible that a small number of additional chicks hatched but were never confirmed as the restrictions in place due to the COVID-19 pandemic prevented aerial surveys from being conducted, resulting in some pairs not being monitored due to their locations in remote areas of marsh.

SURVIVAL

As of 30 June 2020, 149 juvenile Whooping Cranes have been released in Louisiana since 2011. Additionally, eight wild-hatched chicks have fledged (1 each in 2016, 2017, and 2020, and 5 in 2018), and two adult females were relocated from the discontinued Florida reintroduction to Louisiana. In total, 159 Whooping Cranes have been reintroduced during the 9.5 years of the project, and as of the end of this report period, a maximum of 76 (47.8%) individuals have survived.

Mortality and Morbidity
The following five mortalities were recorded during the report period:

LW4-18: female, Cameron Parish, Louisiana, 12 July – 5 August, unknown/suspicious circumstances
L11-18: male, Jefferson Davis Parish, Louisiana, 14-15 November, gunshot (under investigation)
L5-19: female, Vermilion Parish, Louisiana, 10-16 December, suspected predation
L7-19: female, Vermilion Parish, Louisiana, 27 December, suspected predation
L5-17: female, Jefferson Davis Parish, Louisiana, 12-16 February, suspected predation of injured bird

One additional crane was observed with minor injuries that resolved on their own and did not require intervention:

L12-17: On 18 October, female L12-17 was observed with a severely lame right leg in Vermilion Parish and her right foot appeared swollen during an observation on 24 October. However, her behavior appeared normal and there was no obvious visible reason for her injury. By 13 November, she had improved to a mild to moderate limp, and by 18 November, she was walking normally, although her right foot/toes were twisted inward.

Through the end of the reporting period, there have been 83 mortalities since the start of the reintroduction; 66 confirmed by recovery of remains and 17 others inferred based on supporting evidence or long-term missing status. Of mortalities where remains were recovered, the primary contributing factor of death could not be determined in 18 cases (27.3%) due to severely degraded or minimal remains recovered. The primary known or suspected cause of mortality in the remaining cases (n = 48) was trauma (33.3%) followed by gunshot (31.3%) and predation (25.0%). Twelve trauma mortalities (18.0% of mortalities where remains were recovered) are attributed to collisions with power lines or fences. The highest number of mortalities continue to occur in May and to juvenile cranes less than nine months after release (Figs. 6, 7).

Powerline Marking
Collision with powerlines accounts for a significant percentage of mortality in the Louisiana population and is one of two sources of mortality that we can attempt to lessen through management actions. Although not every line can be marked, lines that may pose a greater risk can be identified and targeted for marking with devices that make them more visible to cranes. In 2017, three cranes died as a result of colliding with a stretch of distribution line on WLWCA's Tract G property. LDWF staff met with the power company, Slemco, to request that section of line be marked in order to prevent future collisions, since cranes continue to use that property. Slemco was very willing to work with us, purchased the bird flight diverters, and installed them in August (Fig. 8). LDWF biologists have identified numerous additional sections of both transmission and distribution lines that could be hazardous to Whooping Cranes in areas where they spend time and have established territories. We plan to meet with additional power companies about marking some of these lines in the future.

EDUCATION, OUTREACH, AND MEDIA

Outreach
LDWF staff participated in 11 outreach events where literature and information were delivered or made available to the public. An estimated 532 individuals were exposed to information regarding Whooping Cranes in Louisiana through presentations made at parish crawfish association meetings, National Hunting and Fishing Day, a Zoo Day event hosted by the Audubon Zoo as part of the annual AZA conference along with several other venues.

Due to the decreased opportunity to participate in standard outreach events, and thanks to a generous donation from the Woman's Club of Lafayette, a new traveling display was created and premiered in September of 2019 (Fig. 9). The display will rotate on a monthly basis between parish libraries, focusing on areas where the cranes are most frequently located. This form of outreach has the potential to reach large numbers of individuals while requiring minimal staff time. Information contained within the display includes Whooping Crane facts, keys to identification, their history in Louisiana and areas currently used by the reintroduced population. The display also provides the public with ways they can support the project through various means, including donations and reporting sightings and any violations they may have witnessed. After debuting in September, the display rotated through seven libraries in three different parishes, reaching 349 individuals, prior to being put on hold due to the coronavirus pandemic.

The Louisiana Department of Wildlife and Fisheries-Whooping Crane Facebook page continues to grow in popularity, gaining 1,240 "likes" during the reporting period. This method of outreach has been well received with over 10,000 individuals now following the page since its creation in August 2015.

Media and Public Awareness
The LDWF public outreach media plan once again included the use of billboard space provided by Lamar Advertising and several Whooping Crane television and radio spots that aired on several outdoor sportsman shows.

LDWF purchased vinyl signs from Lamar with sizes ranging from 11 x 36 to 12 x 40 feet. The billboards were displayed in three markets around the state on space donated by Lamar. The targeted markets (and number of boards per market) included Alexandria (2), Lafayette (2) and Lake Charles (2). These billboards resulted in excess of 675,000 weekly views by the traveling public during the timeframe all signs were in place. The design once again featured a message aimed at preventing the poaching of Whooping Cranes along with phone numbers to report poaching or injuring of Whooping Cranes. The signs were placed in high traffic areas, including on I-10 between Iowa and Jennings and on I-49 in Alexandria at the intersection with heavily-traveled MacArthur Boulevard. The signs placed on the interstate locations remained until a new ad buy the following year.

The radio ad buys appeared on the Outdoors with Don Dubuc Radio Network on Saturdays from 5-7 am, More Outdoors on WWL-FM radio and live streaming at dontheoutdoorsguy.com. The radio ad buys included the following:

- One thirty second recorded ad on each show for 44 weeks
- One additional thirty second bonus public service ad each week on the More Outdoors show at no charge for a total of 52 ads
- Minimum of two live 3-minute radio interviews with LDWF and LWFF personnel to outline the Whooping Crane program on “More Outdoors” 7-9am Saturday program during the 10-month contract period.

The television ads appeared on Bayou Wild TV and included:

- One thirty second recorded ad on each of 264 shows airing over 44 weeks for a total of 264 ads
- One additional public service bonus ad, same schedule as above paid ads (total of 264)
- Minimum of one TV feature outlining the Whooping Crane program
- A link to the Whooping Crane information page on the LDWF and LWFF pages on dontheoutdoorsguy.com and bayouwildtv.com websites.

RESEARCH PRODUCTS

Presentations
Szyszkoski, E.K., P.L. Vasseur, and S.E. Zimorski. 2018. Monitoring Whooping Crane Nests in Louisiana Through the Use of Trail Cameras. 15th North American Crane Workshop, Lubbock, TX. Poster presentation.

Vasseur, P.L., E.K. Szyszkoski, S.E. Zimorski, and J.R. Marty. 2020. Comparison of Human- and Camera-Monitored Whooping Crane Nests to Determine an Effective Surveillance Rate. 15th North American Crane Workshop, Lubbock, TX. Poster presentation.

*Szyszkoski, E.K., **S.E. Zimorski**, and P.L. Vasseur. 2020. An Update on the Louisiana Non-migratory Whooping Crane Reintroduction. 15th North American Crane Workshop, Lubbock, TX. Oral presentation.*

*Vasseur, P.L., **S.L. King**, M.D. Kaller, and S.E. Zimorski. 2020. Behavior Analysis and Long-Term Survival of Captive-Reared Juvenile Whooping Cranes in the Reintroduced Louisiana Nonmigratory Population. 15th North American Crane Workshop, Lubbock, TX. Oral presentation.*

Table 1. Distribution of location data points collected via remote tracking devices for the Louisiana non-migratory Whooping Crane population, 1 July 2019 – 30 June 2020. Numbers of individuals contributing to location data totals are given in parentheses.

Cohort (by hatch year)	No. of Location Data Points	No. of points in Louisiana by Parish				No. of points in Texas by County			No. of points outside Louisiana & Texas[c]
		Cameron	Jefferson Davis	Vermilion	Other Parishes[a]	Chambers	Jefferson	Other Counties[b]	
HY1998 (1)	1098	43	241	634	180	-	-	-	-
HY2011 (2)	1341	-	1069	-	272	-	-	-	-
HY2012 (2)	1343	381	-	941	6	-	15	-	-
HY2013 (2)	417	123	-	208	86	-	-	-	-
HY2014 (3)	1507	449	-	1058	-	-	-	-	-
HY2015 (4)	2455	132	13	2108	68	33	101	-	-
HY2016 (8)	7555	1052	1095	1818	1396	1159	1035	-	-
HY2017 (11)	9303	1240	436	3702	1061	921	936	11	996
HY2018 (7)	6629	342	2576	1273	675	-	30	1733	-
HY2019 (8)	3917	18	106	3771	7	-	-	15	-
Totals	35565 (48)	3780 (33)	5536 (20)	15513 (36)	3751 (26)	2113 (8)	2117 (13)	1759 (8)	996 (1)

[a]Acadia, Allen, Avoyelles, Calcasieu, Evangeline, Lafayette, Natchitoches, Ouachita, Rapides, Red River, St. Landry & Vernon.
[b]Hardin, Jasper, Liberty, Limestone, Madison, Newton, Orange, Robertson, San Jacinto & Walker.
[c]Includes 1 county in Tennessee, 2 in Alabama, 2 in Mississippi, 5 in Missouri, 5 in Arkansas & 5 in Oklahoma.

Table 2. Time spent over 325 kilometers from release locations by cranes in the Louisiana nonmigratory population, 1 July 2019 – 30 June 2020. * denotes females.

Crane ID(s)	Date departed buffer zone	Locations visited (roost locations only; as indicated by GPS)[a]	Date returned to w/in 325km	Consecutive nights spent >325km
L1, 2*[b], 5[b], 6 & 7-18*	NA; began outside zone	Limestone County, Texas	23 Nov	145
L1-18 & 6-18	6 May	**Limeston**e & Madison Counties, Texas	NA; ended outside zone	56
L7-18*	22 May	Limestone County, Texas	NA; ended outside zone	40
L4-17*	NA; began outside zone	Creek, Muskogee & **Okfuskee** Counties, Oklahoma; Pope County, Arkansas; Limestone & **Morgan** Counties, Alabama	7 March	250
	8 March	Crawford & Franklin Counties, Arkansas; Bates, Henry, Johnson, & Vernon Counties, Missouri; Delaware, **Okfuskee**, Wagoner Counties, Oklahoma	NA; ended outside zone	115

[a] For individuals or groups using multiple locations and spending over 5 consecutive nights out-of-state, area with most roost points are indicated in **bold**.

[b] Indicates individuals with VHF only or nonfunctional remote transmitter. Out-of-state time estimated based on visual tracking data or movement of known associates.

Table 3. Summary of captures of free-flying Whooping Cranes in the Louisiana non-migratory population, 1 July 2019 - 30 June 2020.

ID	Sex	Date	Method	Reason	Parish	Notes
L17-16	M	11/21/2019	hand grab	transmitter replacement	Vermilion	WLWCA pen
L11-15	F	11/21/2019	hand grab	transmitter replacement	Vermilion	
L1-17	M	11/25/2019	leg noose	transmitter replacement	Vermilion	
L12-18	F	12/10/2019	hand grab	transmitter replacement	Vermilion	
L7-18	F	12/16/2019	leg noose	transmitter replacement	Vermilion	

Table 4. Breeding history of egg laying pairs in the Louisiana non-migratory population of Whooping Cranes through 30 June 2020. Only confirmed nests are included in totals.

Male	Female	Pair formed	# of nest attempts/year							Chicks		Egg information				Pair dissolved
			2014	2015	2016	2017	2018	2019	2020	Hatched	Fledged[f]	Infertile/ nonviable	Fertile		Unk[a]	
													Dead	Hatch		
L8-11	L7-11	Dec 2013	2	2	2	3	3			1[b]		22			2	July 2018[c]
L10-11	L11-11	Dec 2013			2	2	1			1[b]	1	1	3		2	Mar 2018[c]
L1-11	L6-11	Jan 2015		1		1				0			2		1	July/Aug 2017[d]
L2-11	L13-11	Apr 2015		1	2	4	1	2	1	1[b]		6	3	2	7	
L1-13	L3-11	May 2015		1	2	3	2	3	2	2[b]	1	4	12[e]	1	7	
L3-13	L11-12	Nov 2015				2				0		1	1		1	Dec 2017[c]
L8-13	L6-12	Jan 2016			1	2	1			4	3	1	1	4	1	Feb 2019[c]
L14-12	L2-12	Mar 2016				1				1				1		May 2017[c]
L12-16	L5-14	Jan 2018					2	4	7	2	1	4	4	2	7	
L13-14	L6-15	Jan 2018					1	1		0					4	
L2-15	L7-14	Jan 2018					1	1		1		1	1	1	1	
L19-16	L10-15	Feb 2018					1	4	2	2[b], 2	1	6	4	3		
L3-13	L8-14	July 2018						2	1	0		3			1	
L6-16	L16-17	Dec 2018						1	1	1				1	2	
L3-14	L2-12	Jan 2019						1		0		1	1			
L12-14	L8-15	Jan 2019						2		0		1	2			June 2019[d]
L13-16	L14-16	Jan 2019						1	1	1				1	1	
L11-17	L7-11	Jan 2019						2	3	0		5	2		3	
L8-13	L11-11	Feb 2019						3	1	2	1	1		2	4	
L23-16	L11-15	Sept 2019							1	0			1			
L22-17	L8-16	Mar 2019							1	1				1		
L26-16	L16-16	Mar 2020							1	0					1	
Totals			**2**	**5**	**9**	**18**	**13**	**27**	**22**	**22**	**8**	**57**	**37**	**19**	**45**	

[a] Includes eggs that disappeared, were broken, or fertility could not be determined upon examination.
[b] Hatched from fertile egg(s) swapped into the nest while the pair's own eggs were removed.
[c] Death or injury of one member of the pair.
[d] Disappearance of one or both members of the pair.
[e] One fertile/viable egg pulled at day 8-10 died while hatching at captive center.
[f] Fledging date may be after the end of the report period.

Table 5. Data-logging egg deployments in Louisiana Whooping Crane nests, 2020.

Female	Male	Egg deployed	Egg removed	Days deployed
L5-14	L12-16	7 February	6 March	28
L16-17	L6-16	11 March	25 March	14
L10-15*	L19-16	11 March	11 March	0

*Pair did not return to normal incubation following deployment, likely due to presence of camera

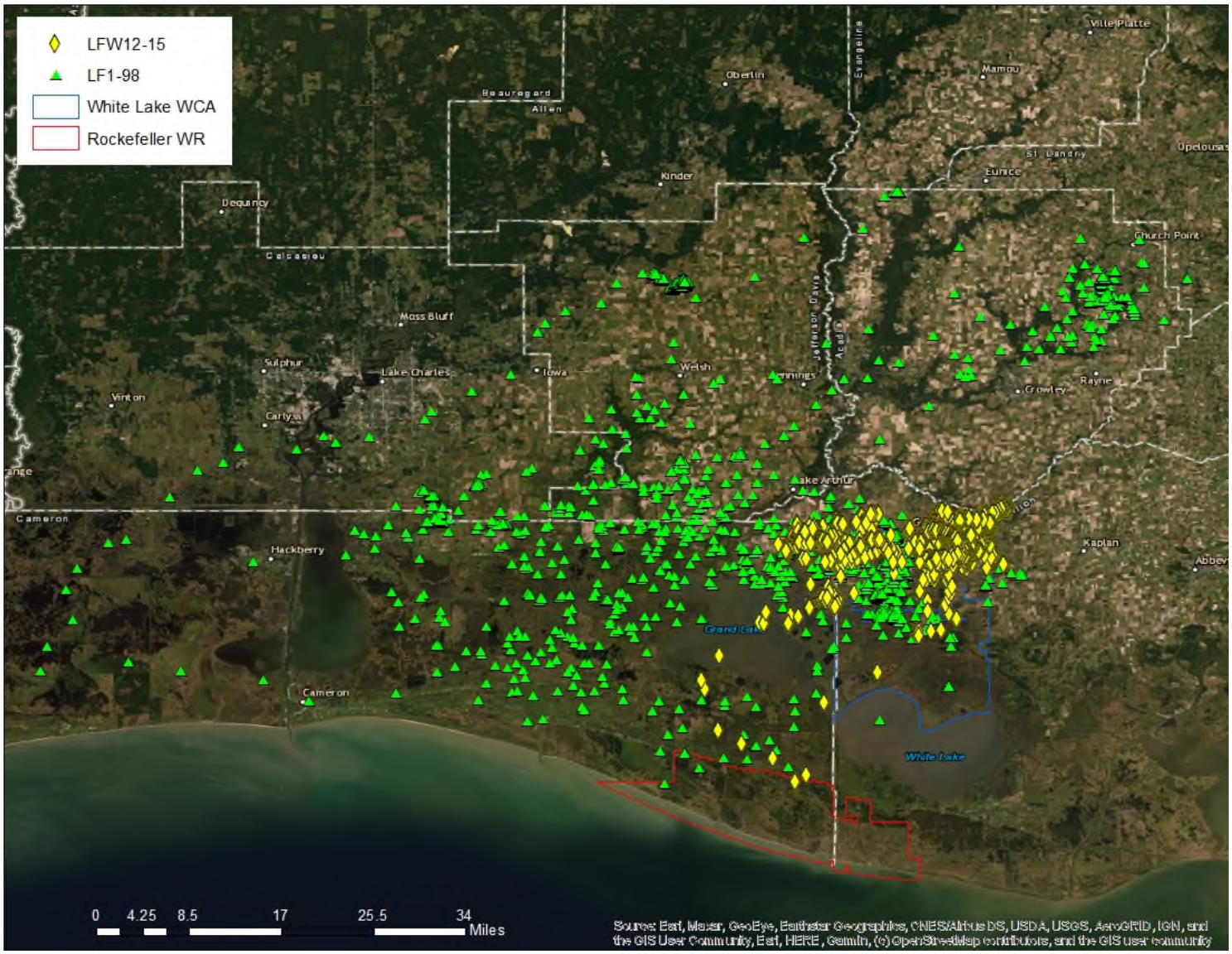


Figure 1. Location data from remote transmitters (1 July 2019 – 30 June 2020) of two adult female Whooping Cranes translocated to Louisiana from Florida and released at WLWCA in Vermilion Parish.

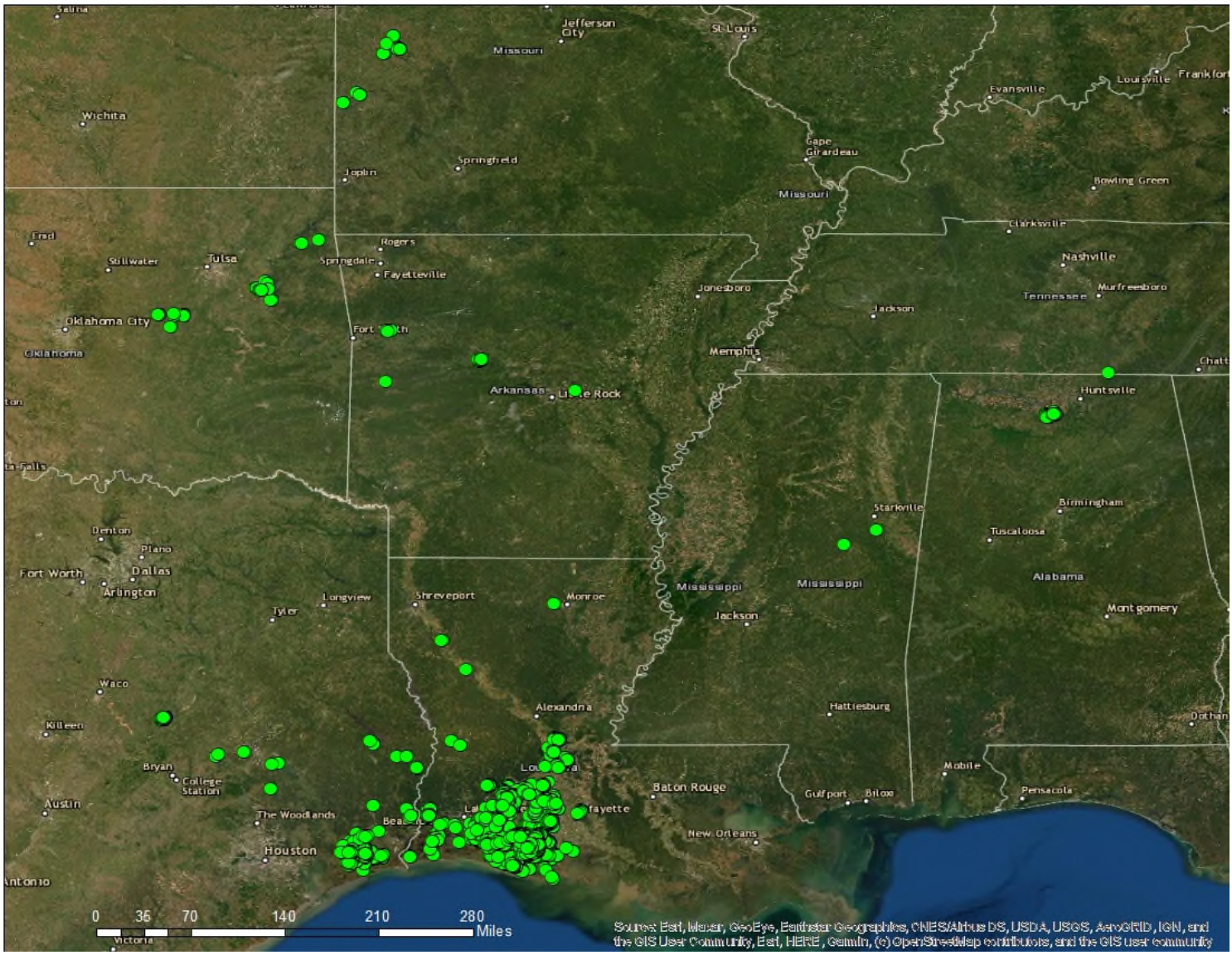


Figure 2. Location data collected from remote transmitters of reintroduced Whooping Cranes, 1 July 2019 – 30 June 2020.

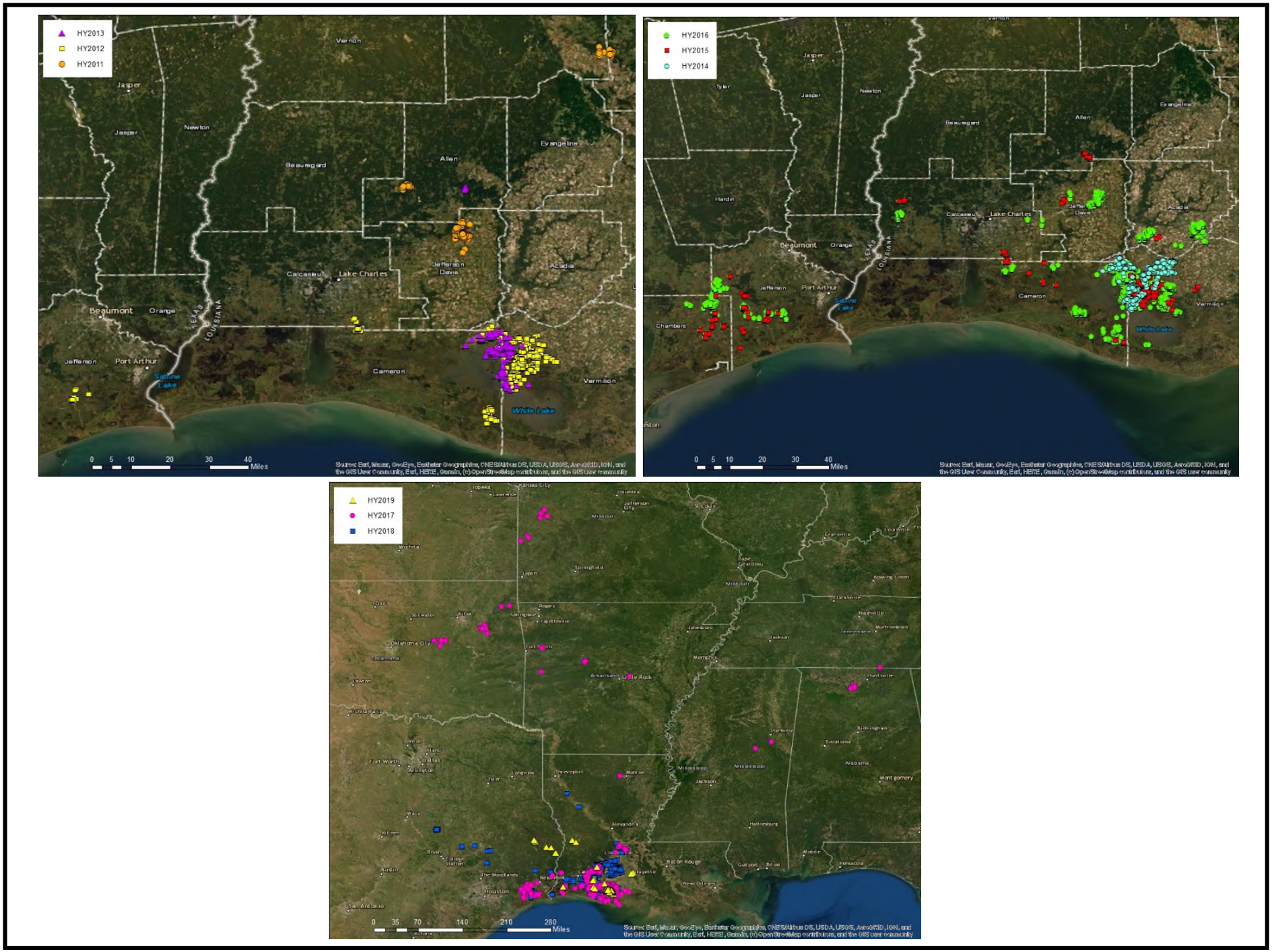


Figure 3. Location data of reintroduced Whooping Cranes in Louisiana by hatch year, 1 July 2019 – 30 June 2020.

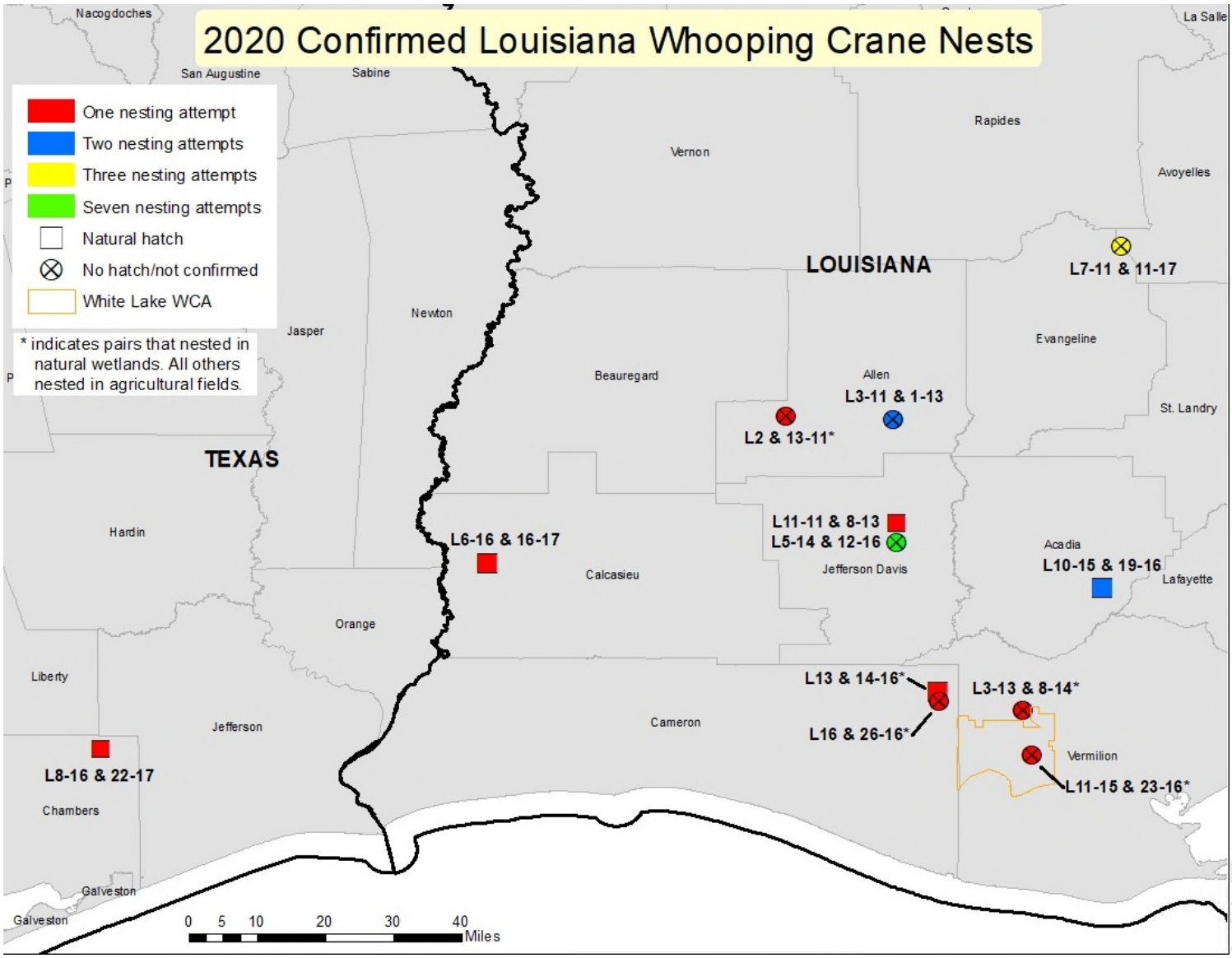


Figure 4. Approximate locations of Louisiana Whooping Crane nests in 2020.

Figure 5. Trail camera documentation of the reduction in height of L6-16 & L16-17's nest in Cameron Parish after experimental elevation.

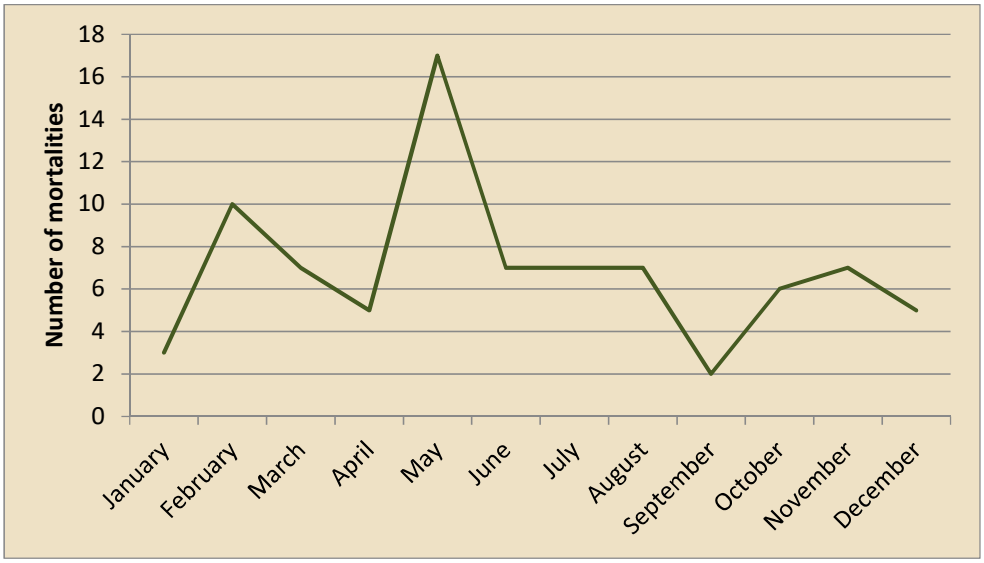


Figure 6. Whooping Crane mortalities by time of year throughout the entirety of the project, 2011-July 2020.

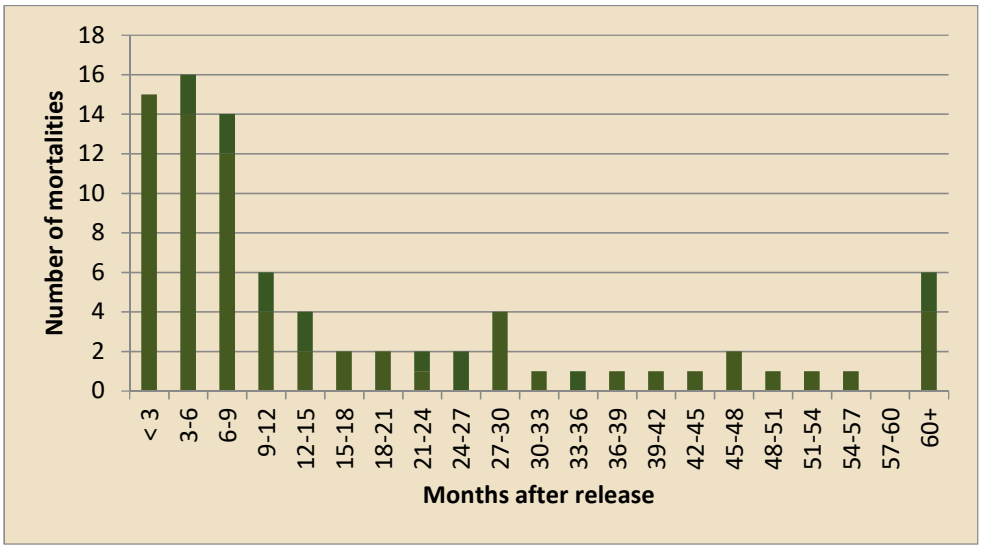


Figure 7. Whooping Crane mortalities by months after release.

Figure 8. Power Line Sentry Bird Flight Diverters installed on two mile stretch of distribution line at WLWCA Tract G

Figure 9. Louisiana Whooping Crane traveling display, Grand Lake library, Cameron Parish.

APPENDIX A: Complete Nesting History of the Reintroduced Louisiana Whooping Crane Population

First nests of the season by Whooping Crane pairs in the reintroduced Louisiana non-migratory population, 2014-20.

Year	Male	Female	Parish	Initiation	No. eggs	Outcome of nest, fate of eggs	Days of incubation	Days to renest
2014	L8-11	L7-11	Avoyelles	24 Mar	2	Full term, collected 30 Apr, both infertile	37	18
2015	L8-11	L7-11	Avoyelles	28 Feb	2	Full term, collected 9 Apr, both infertile	40	18
2015	L1-11	L6-11	Vermilion	3/4 Apr	2	Flooded by/on 13 Apr, 1 intact (EDE) & fragments coll. 16 April	9-10	No renest
2015	L2-11	L13-11	Allen	6-14 May	1-2	Failed, shell fragment collected 12 June	27-37	No renest
2015	L1-13	L3-11	Allen	16-28 May	2	Abandoned by ~13 June PM, 1 coll. 17 June, (unk, likely infertile)	16-28	No renest
2016	L1-13	L3-11	Allen	12 Feb	2	Full term, collected 21 Mar, both fertile – 1 MDE, 1 LDE	39	17-21
2016	L8-11	L7-11	Avoyelles	28 Feb	2	Full term, collected 5 Apr, both infertile	38	18
2016	L8-13	L6-12	Jefferson-Davis	~12 Mar	2	Hatched 11 & 13 Apr	33	No renest
2016	L2-11	L13-11	Allen	8-14 Mar	1	Failed/collected 4 Apr (human disturbance), LDE	22-28	31-36
2016	L10-11	L11-11	Jefferson-Davis	1-4 Apr	1	Full term, no fragments/eggs found 3 May	30-33	15-16
2017	L8-11	L7-11	Avoyelles	11 Feb	2	Full term, collected 17 Mar, both infertile	34	19-20
2017	L8-13	L6-12	Jefferson-Davis	11-14 Feb	2	Full term, 1 broke 19 Mar, 2nd coll. 20 Mar, infertile	34-37	26-28
2017	L1-13	L3-11	Allen	17 Feb	1	Full term, collected 22 Mar, infertile	33	17-18
2017	L10-11	L11-11	Jefferson-Davis	18-21 Feb	1	Full term, collected 27 Mar, fertile - LDE	34-37	18-21
2017	L2-11	L13-11	Allen	4-15 Mar	1-2	Failed ~23 Mar, 1 infertile egg found in water 19 April	8-19	17-18
2017	L3-13	L11-12	Vermilion	15-17 Mar	1	Full term, collected 25 Apr, infertile	39-41	20
2017	L14-12	L2-12	Vermilion	~27 Mar	1	Hatched ~26 Apr	30	No renest
2017	L1-11	L6-11	Vermilion	16 Mar-4 Apr	1-2	Failed/abandoned by 18 April, 1 coll. 18 Apr, EDE	14-33	No renest
2018	L10-11	L11-11	Jefferson-Davis	10-12 Feb	2	Full term, DL egg 19 Feb-20 Mar, 1 coll. 19 Feb (MDE); 1 gone 16 Mar	36-38	No renest
2018	L12-16	L5-14	Jefferson-Davis	16-19 Feb	1-2	Full term; eggs disappeared by ~24 Mar	32-35	15
2018	L8-11	L7-11	Avoyelles	21-22 Feb	2	Full term; DL egg 28 Feb-28 Mar, 1 coll. 28 Feb; 1 coll. 28 Mar (2 infertile)	34-35	18
2018	L1-13	L3-11	Allen	25-27 Feb	2	DL egg 6 Mar-3 Apr, 1 coll. 6 Mar (EDE); 1 coll. 3 Apr (EDE)	35-37	18
2018	L2-11	L13-11	Allen	~15 Mar	2	Failed by 3 Apr; 1 found in water (MDE), 2nd broken on nest	~19	No renest
2018	L8-13	L6-12	Jefferson-Davis	~20-21 Mar	2	Hatched 18 & 20 Apr	~30-31	No renest
2018	L19-16	L10-15	Acadia	~15 Apr	2	Coll. 3 May (inf); gave hatched chick/shell & non-viable egg (L7/8-11's)	18	No renest
2018	L13-14	L6-15	Vermilion	~7 May	2	Abandoned 4 June, both broken 11 June (unk fertility)	28	No renest
2018	L2-15	L7-14	Vermilion	~8 May	2	Abandoned 25 May, collected 30 May (infertile, EDE)	~17	No renest
2019	L12-16	L5-14	Jefferson-Davis	13 Feb	2	Full term; DL egg 24 Feb-12 Mar, 1 viable removed & ret. to nest 12 Mar (LDE), 1 hatch 17 Mar	33	~16 (after chick)
2019	L1-13	L3-11	Allen	14 Feb	2	Full term; DL egg 24 Feb – 12 Mar, 1 viable removed & ret. on 12 Mar but LDE, 1 broke 15 Mar, abandoned by 17 Mar	29-30	16
2019	L19-16	L10-15	Acadia	18 Feb	2	Abandoned/coll. 25 Feb (human disturbance)	7	11
2019	L2-15	L7-14	Vermilion	18 Feb	2	Full term; 1 hatched 20-21 Mar, 2nd gone by 29 Mar	30-31	No renest
2019	L11-17	L7-11	Avoyelles	18 Feb	3	Full term; DL egg 25 Feb-20 Mar, two pulled, 1 viable ret. to nest 20 Mar but failed to hatch & disappeared 25-26 Mar	~35-36	18-20
2019	L3-13	L8-14	Vermilion	14-26 Feb	1	Full term; failed to hatch, 1 egg collected 1 Apr	~34	14-22
2019	L6-16	L16-17	Calcasieu	9/10 Mar	2	Full term; failed to hatch, shells found in water 16 Apr	Up to 37	No renest
2019	L8-13	L11-11	Jefferson-Davis	15 Mar	2	Full term, 1 hatch 16 Apr, 1 broke & chick died 18 Apr	34	19
2019	L3-14	L2-12	Vermilion	15-17 Mar	2	Abandoned 12 Apr, 2 eggs (1 viable later LDE) collected 15 Apr	26-28	No renest
2019	L2-11	L13-11	Allen	19 Mar	1	Abandoned/coll. 3 Apr (human disturbance), MDE	15	18
2019	L12-14	L8-15	Vermilion	22 Mar	2	Flooded/abandoned ~5 April, coll. 8 Apr, 1 EDE, 1 no dev	13-14	27
2019	L13-14	L6-15	Vermilion	24 Mar	2	Failed due to unk reasons (possibly deer?) 10 Apr, frags coll. 12 Apr	19	No renest
2019	L13-16	L14-16	Cameron	22-29 Mar	UNK	Failed due to unk reasons 12-22 April, no frag found	14-30	No renest
2020	L12-16	L5-14	Jefferson Davis	2 Feb	2	Full term; DL egg 7 Feb-6 Mar (3 egg nest); 1 broke 29 Feb, 1 broke 8 Mar	35	17
2020	L11-17	L7-11	Avoyelles	3 Feb	1	Full term; coll. 9 Mar (non-viable)	35	19
2020	L23-16	L11-15	Vermilion	8 Feb	1	Coll. 13 Mar (LDE, malpositioned); poor incubation?	~34	No renest
2020	L3-13	L8-14	Vermilion	15-29 Feb	1 or 2	Poss full term; membrane found on nest 2 Apr (possible hatch?)	UNK	UNK
2020	L1-13	L3-11	Allen	19-26 Feb	1	Full term; coll. 30 Mar (MDE)	33-40	17-19
2020	L6-16	L16-17	Calcasieu	22 Feb	1	DL egg 11 Mar-25 Mar; nest elevated 11 Mar; hatch 23 Apr (W1)	30	No renest
2020	L19-16	L10-15	Acadia	27 Feb	2	Full term; coll. 2 Apr (LDE, non-viable)	35	17
2020	L2-11	L13-11	Allen	27 Feb-3 Mar	2	Failed by 30 Mar; no eggs/frag. found 1 Apr	≤27-32	No renest
2020	L8-13	L11-11	Jefferson Davis	28 Feb	2	1 hatch 31 Mar (W2); 1 coll. 6 Apr (non-viable)	32	No renest
2020	L13-16	L14-16	Cameron	~18 Mar	1 or 2	Hatch ~19 Apr (W3, 1 found)	30	No renest
2020	L22-17	L8-16	Jefferson, TX	31 Mar	1 or 2	Hatch ~30 Apr (W4, 1 assumed)	30	No renest
2020	L26-16	L16-16	Cameron	27 Apr	UNK	Failed 18 May; fragments found 29 June	21	No renest

Subsequent nesting attempts by Whooping Crane pairs in the reintroduced Louisiana non-migratory population, 2014-20.

Year	Male	Female	Parish	Initiation	No. eggs	Outcome of nest, Fate of eggs	Days of incubation	Days to next nest
Second nest attempts (renests)								
2014	L8-11	L7-11	Avoyelles	19 May	2	Full term, collected 26 June, both infertile	38	No 3rd nest
2015	L8-11	L7-11	Avoyelles	28 Apr	2	Full term, collected 4 June, both infertile	37	No 3rd nest
2016	L1-13	L3-11	Allen	8-11 Apr	2	Full term, 1 gone ~12 May, 2nd gone 15 May; 1 LDE coll. from water, 16 May	33-37	No 3rd nest
2016	L8-11	L7-11	Avoyelles	24 Apr	2	Full term, failed/abandoned 26-28 May; 1 coll. From water 1 June, infertile	32-34	No 3rd nest
2016	L2-11	L13-11	Allen	6-11 May	2	Poss. full term, failed/abandoned 3-6 June; 1 infertile coll. from water 6 June	23-31	No 3rd nest
2016	L10-11	L11-11	Jefferson-Davis	18/19 May	1	Full term, collected 21 June, infertile	34-35	No 3rd nest
2017	L8-11	L7-11	Avoyelles	5/6 Apr	2	Egg swap 12 Apr; pulled 2 infertile, gave pipped egg	6-7	15-16
2017	L1-13	L3-11	Allen	8/9 Apr	2	Failed/abandoned 3/4 May likely due to flooding rains, eggs disappeared	24-26	15-17
2017	L2-11	L13-11	Allen	~9 Apr	2	Failed 16/17 Apr, 1 intact infertile egg & 1 broken coll. from water 19 Apr	~7-8	12-16
2017	L10-11	L11-11	Jefferson-Davis	14-17 Apr	1	Swap 5 May, pulled egg (F but died – malpositioned), gave pipped egg	18-21	No 3rd nest
2017	L8-13	L6-12	Jefferson-Davis	15-17 Apr	1	Full term, collected 19 May, 1 LDE (malpositioned)	32-34	No 3rd nest
2017	L3-13	L11-12	Vermilion	~15 May	2	Full term, collected 23 June, 1 fertile mid-late DE & egg shell in water	39	No 3rd nest
2018	L12-16	L5-14	Jefferson-Davis	8 Apr	2	Full term; DL egg 12 Apr-3 May, coll. 1 & put back 3 May (LDE), 1 hatch 9 May	33	No 3rd nest
2018	L8-11	L7-11	Avoyelles	15 Apr	2	Failed 25-26 April, nest very small; both infertile	10-11	8-9
2018	L1-13	L3-11	Allen	21 Apr	2	Egg swap/hatch 1 May, 2 coll. – 1 EDE, 1 F LDE -died while hatching at ASSC	10	No 3rd nest
2019	L19-16	L10-15	Acadia	8 March	1	Full term, collected 12 Apr (no dev)	35	14
2019	L1-13	L3-11	Allen	2 April	2	Gave peeping egg 17 Apr, LDE, replaced with plaster egg 22 Apr. Failed due to snake predation 23 Apr. DL egg 10-17 April.	21	~15
2019	L11-17	L7-11	Avoyelles	15 April	2	Full term, disappeared on/by 16 May	30	No 3rd nest
2019	L3-13	L8-14	Vermilion	15-23 April	2	Full term, coll. 24 May (no dev)	31-39	No 3rd nest
2019	L2-11	L13-11	Allen	21 April	2	Egg swap 6 May, LW4-19 hatched 7 May, pulled eggs both hatched in captivity	16	No 3rd nest
2019	L12-16	L5-14	Jefferson Davis	23 April	1	Flooded 25 April, 1 egg found	2	1
2019	L12-14	L8-15	Vermilion	~2 May	1	Abandoned by 21 May, poss. due to flooding 19 May	17-19	No 3rd nest
2019	L8-13	L11-11	Jefferson Davis	7 May	2	Flooded 10 May, abandoned by 11 May, frags coll. 31 May	3-4	12-13
2020	L5-14	L12-16	Jefferson Davis	25 Mar	1	Abandoned 27 Mar; coll. 30 Mar (nonviable)	2	6
2020	L7-11	L11-17	Avoyelles	28 Mar	2	Abandoned 25 Apr (1 egg gone); 1 coll. 28 Apr (LDE)	28	32
2020	L3-11	L1-13	Allen	16-18 Apr	2	Full term; coll. 22 May (1 LDE, 1 MDE)	34-36	No 3rd nest
2020	L10-15	L19-16	Acadia	19 Apr	2	Hatched 19 & 21 May (W5-20 & W6-20)	32	No 3rd nest
Third nest attempts								
2017	L2-11	L13-11	Allen	29 Apr-2 May	2	Failed 3-5 May, collected 9 May, 1 infertile & shell fragment	2-6	12-14
2017	L8-11	L7-11	Avoyelles	15 May	2	Full term, egg swap 20 June, abandoned 21 June, 2 pulled eggs infertile	37	No 4th nest
2017	L1-13	L3-11	Allen	19/20 May	2	Full term, floated 15 June - 1 infertile removed, 1 coll. 26 June (infertile)	37-38	No 4th nest
2018	L8-11	L7-11	Avoyelles	4 May	2	Abandoned AM 11 May; egg swap unsuccessful; 1 inf, 1 unk (put in 10-15 nest)	7	No 4th nest
2019	L12-16	L5-14	Jefferson Davis	~26 April	1	Failed, likely clutch mate of single renest egg, coll. 31 May (broken)	1	~14
2019	L19-16	L10-15	Acadia	26 April	2	Egg swap 3 May, failed by 4 May possibly due to storms, 1 EDE, 1 hatch ASSC	7-8	11
2019	L1-13	L3-11	Allen	8 May	2	Egg/chick (LW6-19) swap 22 May, 1 unk, 1 hatch at WO	14	No 4th nest
2019	L8-13	L11-11	Jefferson Davis	23 May	1-2	Failed unk reasons 28 May, frag coll. 31 May	5	No 4th nest
2020	L5-14	L12-16	Jefferson Davis	2 Apr	1	Abandoned 3 Apr; coll. 6 Apr (nonviable)	1	15
2020	L7-11	L11-17	Avoyelles	27 May	2	Abandoned 5 June; 2 coll. from water 9 June (nonviable)	9	No 4th nest
Fourth - Seventh nest attempts								
2017	L2-11	L13-11	Allen	17 May	2	Full term, collected 20 June, both infertile	34	
2019	L12-16	L5-14	Jefferson Davis	9/10 May	1-2	4th nest; Failed 28-30 May, fragments coll. 31 May	18-20	
2019	L19-16	L10-15	Acadia	15 May	2	4th nest; Chick swap 20 May, both LDE in captivity	5	
2020	L12-16	L5-14	Jefferson Davis	~18 Apr	1	4th nest; abandoned ~20 Apr; coll. 19 May (nonviable)	2	UNK
2020	L12-16	L5-14	Jefferson Davis	UNK	1	5th nest; coll. 12 May (nonviable)	UNK	UNK
2020	L12-16	L5-14	Jefferson Davis	2 May	2	6th nest; abandoned 9 May; 1 coll. 12 May (EDE), 1 broken on nest	7	16
2020	L12-16	L5-14	Jefferson Davis	25 May	UNK	7th nest; failed 3 June; no eggs/fragments found on 8 June	9	

Whooping Crane Eastern Partnership, 2019 Annual Report

MONITORING & MANAGEMENT TEAM

Prepared by Hillary Thompson, Nicki Gordon, Jadine Lee, and Darby Bolt, International Crane Foundation

During 2019, there were about 86 Whooping Cranes in the Eastern Migratory Population. The majority spent the summer in Wisconsin, with the exception of 6 birds that spent all or part of the summer in Michigan, Iowa, or Illinois (Fig. 1). We recorded a total of 36 nests by 22 breeding pairs of cranes, from which 19 chicks hatched. Three of these chicks made it to fledging, migrated south, and wintered with their parents. In June, two one-year-old cranes who were raised at the Calgary Zoo were released at Horicon National Wildlife Refuge. In October, one parent-reared juvenile was released at White River Marsh State Wildlife Area in a territory of a breeding pair of Whooping Cranes. One additional parent-reared juvenile was released in November at Goose Pond Fish and Wildlife Area in Indiana near a group of sub-adult Whooping Cranes. There were ten confirmed mortalities during 2019, due to powerline collisions, gunshot, predation, bacterial infections, and unknown causes. Members of the Whooping Crane Eastern Partnership captured three adult Whooping Cranes during 2019 for transmitter replacement, as well as 2 wild-hatched juveniles for initial transmitter deployment, which will help us track individuals in this population to inform our management decisions and future releases. Additionally, one adult Whooping Crane was captured and removed from the Eastern Migratory Population and was placed back into captivity. He had been frequenting a military airport, was no longer responding to hazing activities, and was causing safety hazards for himself and others. In April-May of 2020, we documented 21 first nests and 2 re-nests, 13 of which hatched at least 17 chicks, although by the end of May nesting season was on-going and a full report of the 2020 breeding season will be in the next annual report.

Highlights related to monitoring and management of the EMP from 2019 (and early 2020) include:

- During 2019, we recorded a total of 36 nests by 25 different pairs breeding in Wisconsin. The numbers reported here are the total we observed but there may have been a few missed short-term nests, or chicks who only lived a few days. Eleven first nest had two eggs removed as part of the active nest management protocol. One re-nest also had eggs removed. Seven nests failed due to unknown causes. One nest was incubated full term, and two nests had unknown outcomes but the pairs were confirmed later without chicks. 19 chicks hatched from 9 first nests and 8 re-nests. Three wild-hatched chicks made it to fledging and they all migrated south (Table 3).

- In April-May 2020, we recorded 23 nests by 21 pairs in Wisconsin. Nest monitoring was limited in early April due to restrictions from COVID-19, so we likely missed a few breeding pairs. We did document 17 chicks hatch from 13 nests, and still had active nests in June 2020. A full report on the 2020 breeding season will be in the next annual report on the Eastern Migratory Population.

- Three adults were captured for transmitter replacement, two wild-hatched chicks were captured for initial banding, and one adult was captured and placed back in captivity during 2019. One additional adult was captured for transmitter replacement in early 2020.

- There were ten mortalities confirmed during 2019 (Table 1): seven in Wisconsin, one in Illinois, one in Alabama, and one in Ontario, Canada.

- We released four parent-reared cranes in 2019. Two one-year-olds were released at Horicon National Wildlife Refuge in June, one juvenile was released at White River Marsh State Wildlife Area in Green Lake County in October, and one juvenile was released at Goose Pond Fish and Wildlife Area in Greene County Indiana in November. One of the one-year-olds died on migration in Illinois due to a powerline strike.

- There were no additional releases, mortalities, or removals from the population during Jan – May 2020.

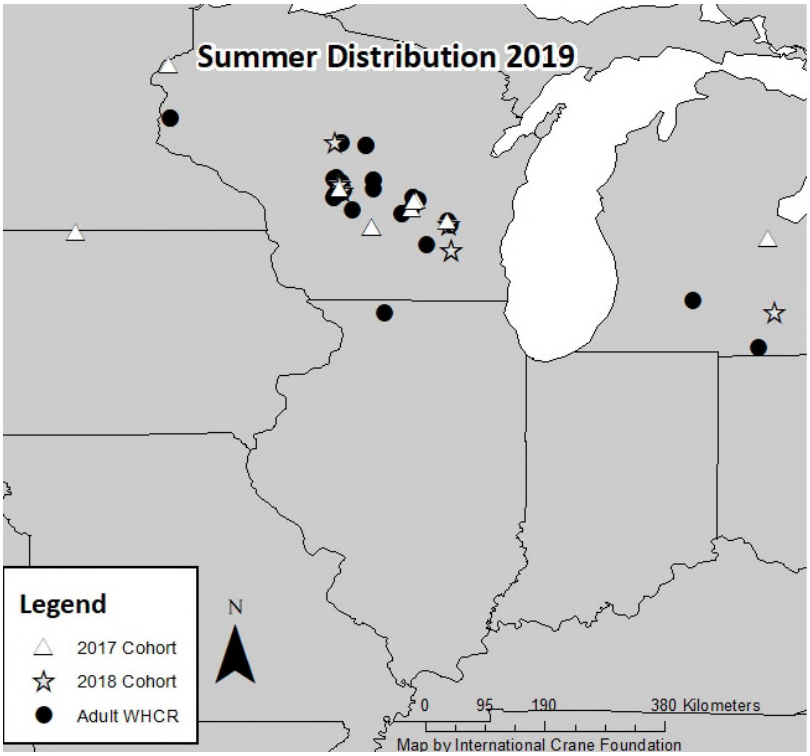


Figure 1. Summer distribution of the Eastern Migratory Population of Whooping Cranes during 2019. At least 74 cranes spent the summer in Wisconsin, 1 in Illinois, 4 in Michigan, and 1 in Iowa.

Winter 2018/2019

The estimated population size as of 7 January 2019 was 101 (45 F, 53 M, 3 U). The final wintering locations of Whooping Cranes in the EMP during winter 2018/2019 were as follows (Figure 2):

- Indiana – 31

- Illinois – 12
- Kentucky – 10
- Tennessee – 7
- Louisiana – 1
- Alabama – 18
- Georgia – 2
- Florida – 5
- Unknown – 15

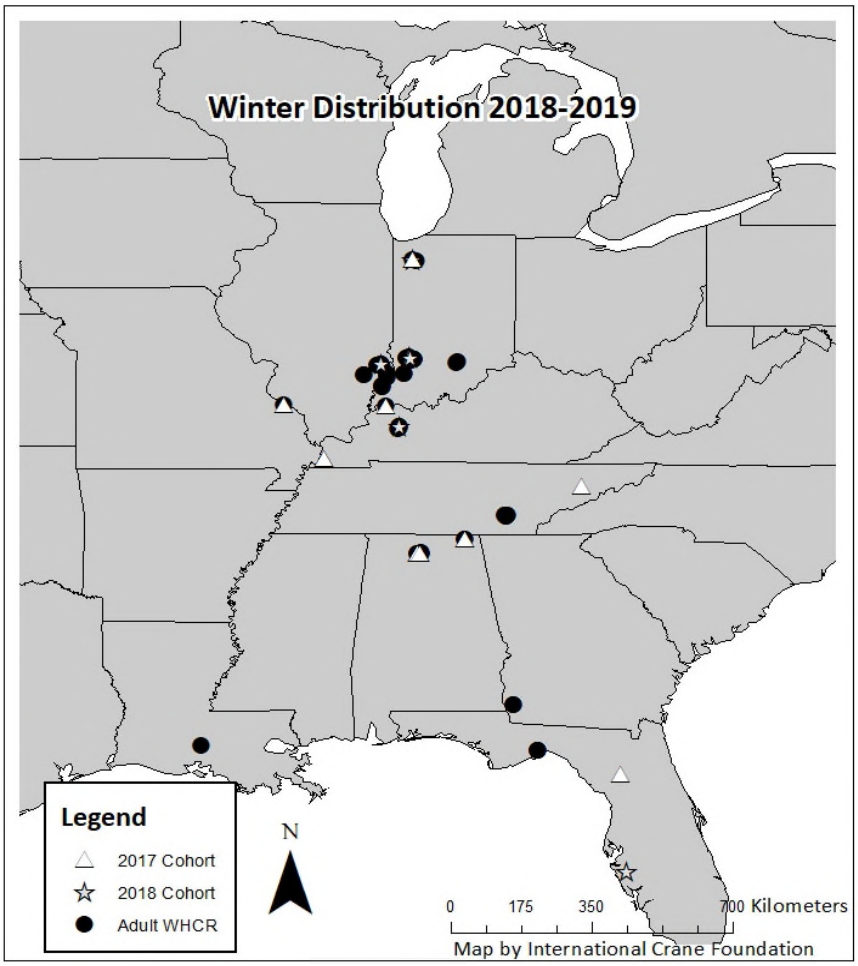


Figure 2. Distribution of the Eastern Migratory Population of Whooping Cranes during winter 2018-2019.

Captures and Banding

- Captures for transmitter replacement:
    - 1-10 Greene County, Indiana, February 18th, 2019
    - 1-11 St. Croix County, Wisconsin, July 22nd, 2019
    - 37-07 Necedah NWR, Wisconsin, August 23rd, 2019
    - 13-03 Greene County, Indiana, February 20th, 2020

- Captures of pre-fledged wild-hatched chicks (transmitter and bands):
    - W1-19 Juneau County, Wisconsin, June 27th
    - W14-19 Necedah NWR, Wisconsin, July 25th
- Captured to remove from EMP and place in captivity due to frequenting a military airport and endangering himself and others:
    - 12-09 Juneau County, Wisconsin, September 24th

Winter distribution as of 1 January 2020

The maximum population size as of 1 January 2020 was 86 (41 Female, 42 Male, 3 Unknown). The distribution of these birds at this time is as follows (Figure 3):

- Indiana – 34
- Illinois – 9
- Kentucky – 4 confirmed, 3 assumed
- Tennessee – 2
- Alabama – 20
- Georgia – 2 assumed
- Florida – 2
- Unknown – 8

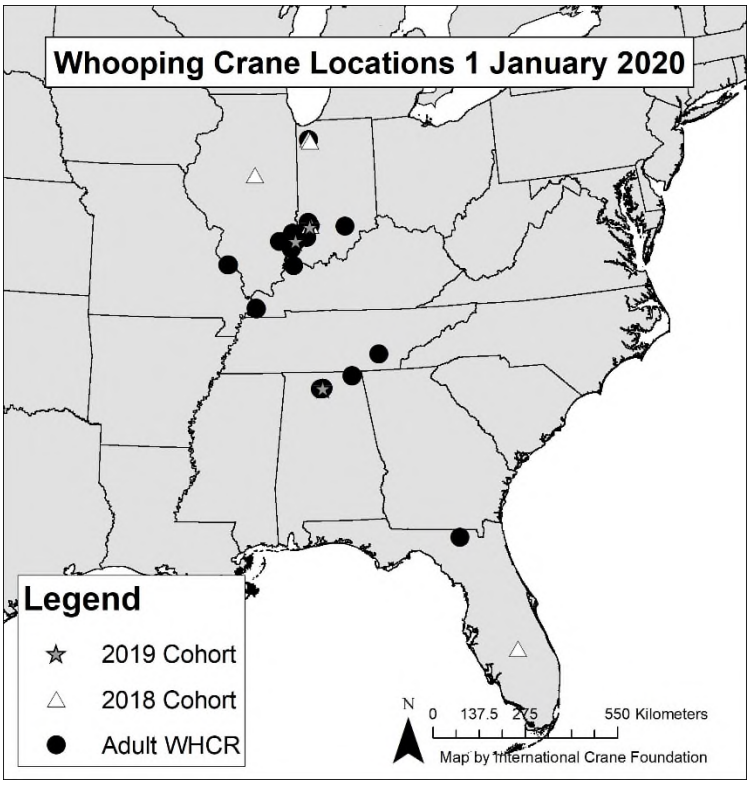


Figure 3. Distribution of wintering Whooping Cranes in the Eastern Migratory Population as of 1 January 2020.

Survival

- As of 31 December 2019, there have been 295 Whooping Cranes released since the beginning of the reintroduction in 2001. This number does not include the 17 HY2006 ultralight-led juveniles that died during confinement in a storm and one HY2007 ultralight-led juvenile that was removed from the project prior to release. There have been twenty-four wild-hatched chicks that survived to fledging, twenty-one of which have been recruited to the EMP (see Reproduction section below). The total released or wild-hatched chicks in this population since 2001 is 316 (Figure 4), of which 86 (27.2%) may be alive as of 1 January 2020 (Figure 5).

- There were ten confirmed mortalities recorded in 2019 (not including wild-hatched chicks born in 2019, Table 1):
  - 25_17 – 18 January, euthanized after powerline collision
  - 19_17 – 9 May, powerline collision
  - 39_17 – 9 May, gunshot
  - 8_04 – 31 May, bacterial infection
  - 29_16 – died during 2018, remains collected May 2019, cause unknown
  - 3_11 – 6 June, bacterial infection
  - 41-09 – died during 2018, remains collected June 2019, cause unknown
  - 9_03 – 3 July, predation
  - 16_07 – 17 August, cause unknown
  - 78_18 – 12 November, powerline collision

Table 1. Causes of death for fledged, wild-hatched and captive-reared Whooping Cranes in the Eastern Migratory Population. We did not include confirmed mortalities for wild-hatched pre-fledged chicks. Other causes of mortality included euthanasia due to injuries, hemorrhages, capture myopathy, emaciation, and egg binding.

Cause of Death	**Number of cases cumulatively 2001-2018**	**Number of cases 2019**
Predation	37	1
Impact Trauma – confirmed or suspected power line collision	7	3
Impact Trauma – other (vehicle or aircraft collision, unknown source of trauma)	11	0
Gunshot	13	1
Disease	5	2
Other	14	0
Unknown	68	3
Total confirmed mortalities	155	10

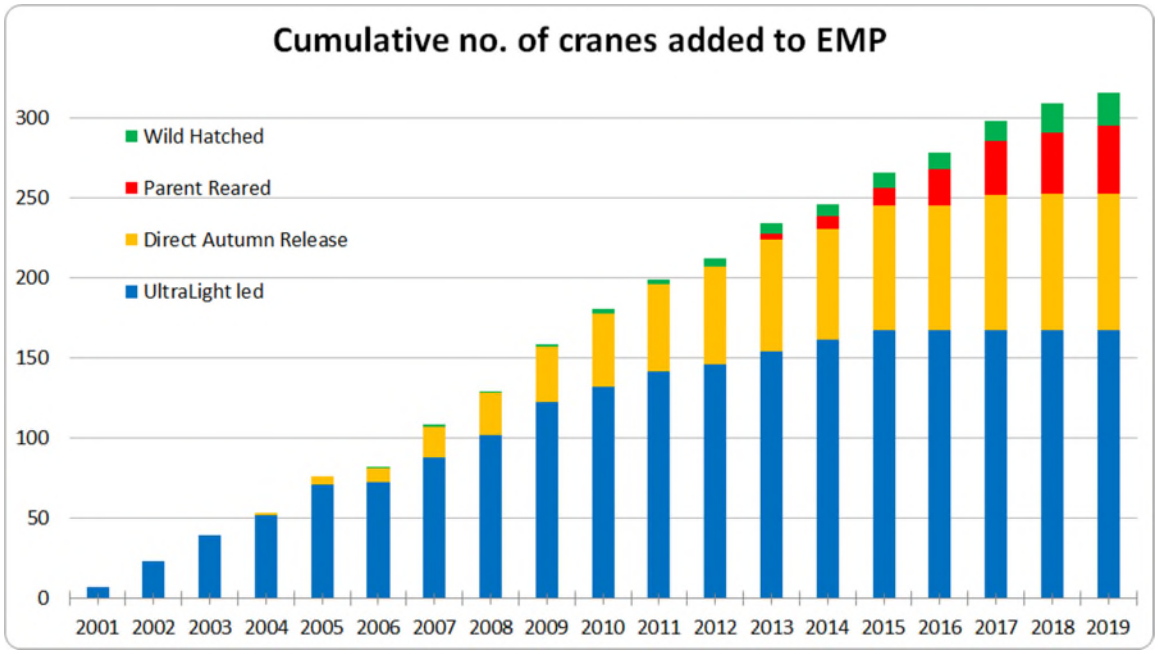


Figure 4. Cumulative number of cranes added to the Eastern Migratory Population by rearing method since 2001. As of 2019, there have been 167 UltraLight led, 86 Direct Autumn Release, 42 Parent Reared, and 21 Wild Hatched Whooping Cranes added to the EMP.

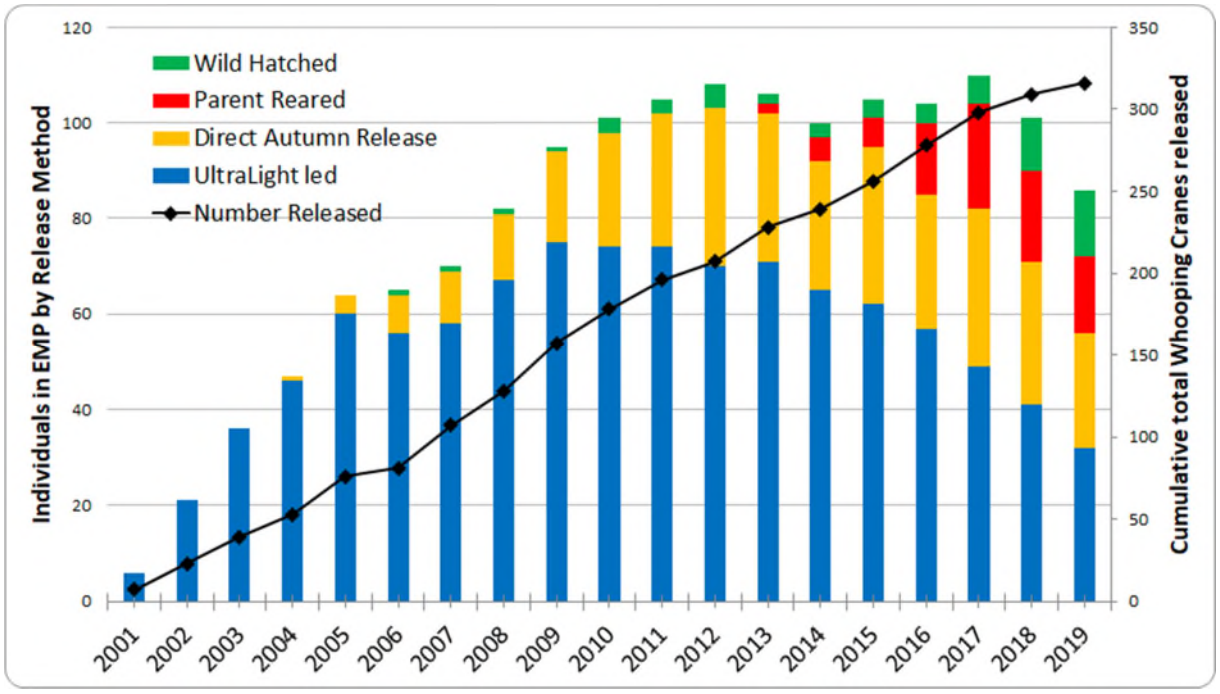


Figure 5. Population size of EMP by rearing method. As of 1 January 2020, there were 86 birds recorded in the EMP (left axis; 41 males, 42 females, 3 unknown). Black line indicates the total birds released into the population cumulatively (right axis; same number as figure 4, above).

Reproduction

- This year we recorded a total of 36 nests by 25 different pairs breeding in Wisconsin. The numbers reported here are the total we observed but there may have been a few missed short-term nests, or chicks who only lived a few days.
- Ten first nests had eggs removed as part of the active nest management protocol. An additional first nest had eggs removed because it was near a busy airstrip at a military airport. One second nest had eggs removed when one adult was found dead near the nest.
- 7 nests failed due to unknown causes. One nest was incubated full term, and two nests had unknown outcomes but the pairs were confirmed later without chicks.
- 19 chicks hatched from 9 first nests and 8 re-nests (Table 2). Three wild-hatched chicks made it to fledging and migrated south (Table 3).
- At the end of 2019, there have been a total of 331 nests (253 first nests, and 78 re-nests), leading to 135 chicks hatched in the wild and 24 fledged chicks. As of 31 December 2019, thirteen wild-hatched birds survive in the wild (Tables 3 and 4).
- In early 2020, we documented 23 nests by 21 pairs, hatching 17 chicks from 13 nests. There are still active nests, thus a full 2020 breeding report will be in the next annual report. We had limited nest monitoring in April 2020 due to restrictions from COVID-19 and did not implement forced re-nesting on a large scale. We did collect two fertile eggs from one nest that was likely to be impacted by black flies and put them in the nest of two female Whooping Cranes, who hatched at least one chick.

Table 2. Nesting summary for 2019. Asterisks indicate a re-nest.

Female	Male	Nest Outcome	Date Completed	County	Chicks	Notes
12_11	5_11	Hatched (1 of 2)	5/3/2019	Juneau	W1-19	W1-19 survived to fledge and migrated with parents
42_09	24_09	Hatched (1 of 2)	5/7/2019	Adams	W2-19	Male 24-09 and chick both disappeared after 23 May
59_13	1_11	Failed	4/15/2019	St. Croix		Snow storm on 11 April. Pair seen on 15 April and were not nesting.
W1_06	1_10	Active Nest Management	4/20/2019	Juneau		
6_15	37_07	Active Nest Management	4/20/2019	Juneau		
25_09	2_04	Active Nest Management	4/20/2019	Juneau		
24_08	13_02	Active Nest Management	4/21/2019	Juneau		
36_09	18_03	Active Nest Management	4/20/2019	Juneau		

13_03	9_05	Active Nest Management	4/20/2019	Juneau		
27_14	10_11	Hatched (2 of 2)	5/10/2019	Marquette	W3-19, W4-19	Both chicks had disappeared by 27 May.
23_10	4_08	Active Nest Management	4/20/2019	Juneau		
W3_10	8_04	Hatched (2 of 2)	5/14/2019	Juneau	W5-19, W6-19	Male 8_04 found dead on 31 May. Both chicks had disappeared by 13 June.
9_03	3_04	Active Nest Management	4/20/2019	Juneau		
16_07	7_07	Active Nest Management	4/20/2019	Juneau		
12_03	12_05	Active Nest Management	4/20/2019	Juneau		
7_11	3_11	Failed	4/26/2019	Adams		Unknown why this nest failed
3_14	4_12	Failed	5/4/2019	Marquette		Unknown why this nest failed
10_15	4_13	Unknown/ Full Term	5/23/2019	Marquette		Pair sat full term but we were unable to determine whether eggs hatched
W3_17	30_16	Unknown/ Full Term	5/15/2019	Marquette		Eggshell seen on 15 May. Inconclusive photos on whether a chick is present or not.
67_15	3_17	Failed	4/26/2019	Marquette		Unknown reason for nest failure
7_17	4_14	Failed	5/3/2019	Green Lake		Unknown reason for nest failure
69_16	12_09	Active Nest Management	5/3/2019	Juneau		Collected two eggs. Found 3rd egg buried in nest.
15_11	29_08	Hatched (2 of 2)	5/20/2019	Juneau	W7-19, W8-19	Both chicks disappeared by 6 June.
W18_15	19_10	Hatched (1 of 2)	5/25/2019	Juneau	W9-19	Female W18-15 and chick both disappeared by 23 July.
5_10	28_08	Hatched (2 of 2)	5/31/2019	Marathon	W10-19, W11-19	Both chicks had disappeared by 28 June.

13_03	9_05	Failed*	5/12/2019	Juneau		Unknown why this nest failed
W1_06	1_10	Failed*	5/6/2019	Juneau		Unknown why this nest failed
25_09	2_04	Hatched (1 of 2)*	6/2/2019	Juneau	W12-19	Chick not seen on 3 July.
36_09	18_03	Hatched (1 of 2)*	6/4/2019	Juneau	W13-19	Chick not seen on 17 June.
12_03	12_05	Hatched (1 of 2)*	6/6/2019	Juneau	W14-19	W14-19 survived to fledge and migrated south with parents
16_07	7_07	Hatched (1 of 2)*	6/6/2019	Juneau	W15-19	Chick not seen on 16 June.
24_08	13_02	Hatched (1 of 2)*	6/5/2019	Juneau	W18-19	W18-19 found dead on 20 June
9_03	3_04	Hatched (2 of 2)*	6/7/2019	Juneau	W16-19, W17-19	Female 9-03 found dead 3 July and both chicks had disappeared by 2 August
7_11	3_11	Active Nest Management*	6/6/2019	Adams		Collected eggs on 6 June after 3_11 died. One egg hatched in captivity and the chick 80-19 was released in fall.
59_13	1_11	Unknown/ Full Term*	5/29/2019	St. Croix		59-13 disappeared for a period of time - assume they were nesting but did not locate nest. Unknown nest outcome
13_03	9_05	Hatched (1 of 2)*	6/22/2019	Juneau	W19-19	Third nest attempt for this pair. W19-19 survived to fledge and migrated south with parents.

Table 3. Nest initiation dates, number of nests, number of chicks hatched, and number of chicks fledged 2005-2019

Year	First Nest Initiation	# First Nests	# Re-nests	Total Nests	# Hatched	# Fledged
2005	16 Apr	2	0	2	0	0
2006	5-6 Apr	5	1	6	2	1
2007	3 Apr	4	1	5	0	0
2008	7 Apr	11	0	11	0	0
2009	2 Apr	12	5	17	2	0
2010	<1 Apr	12	5	17	7	2
2011	3-4 Apr	20	2	22	4	0
2012	<26 Mar	22	7	29	9	2
2013	15 Apr	21	2	23	3	1
2014	7 Apr	25	3	28	13	1
2015	1-3 Apr	27	9	36	24	3
2016	29-31 Mar	25	16	41	24	3*
2017	30 Mar	25	10	35	18	2
2018	8 Apr	17	6	23	10	6*
2019	30 Mar	25	11	36	19	3
Total		253	78	331	135	24

*One chick was old enough to have fledged when it died, but flights were never observed.

Table 4. Pairs that have successfully fledged chicks with years of fledging

Sire	**Dam**	**Year(s)**		
11_02	17_02	2006		
3_04	9_03	2010	2013	2015
12_02	19_04	2010	2012	2014
9_05	13_03	2012	2019	
10_09	17_07	2015		
2_04	25_09	2015		
29_09	12_03	2016		
1_04	8_05	2016		
12_02	4_11	2016*		
14_08	24_08	2017	2018**	
24_09	42_09	2017	2018	
5_11	12_11	2018	2019	
4_08	23_10	2018		
8_04	W3_10	2018		
1_04	16_07	2018		
12_05	12_03	2019		

*12-02 died before chick fledged. Chick was old enough to have fledged when it died, but flights were never observed. 4-11 was found shot at her wintering area at the beginning of 2017.

** 14-08 disappeared before chick fledged and 14-08 is believed to be dead. The chick (W9-18) was old enough to have fledged when it died, but flights were never observed.